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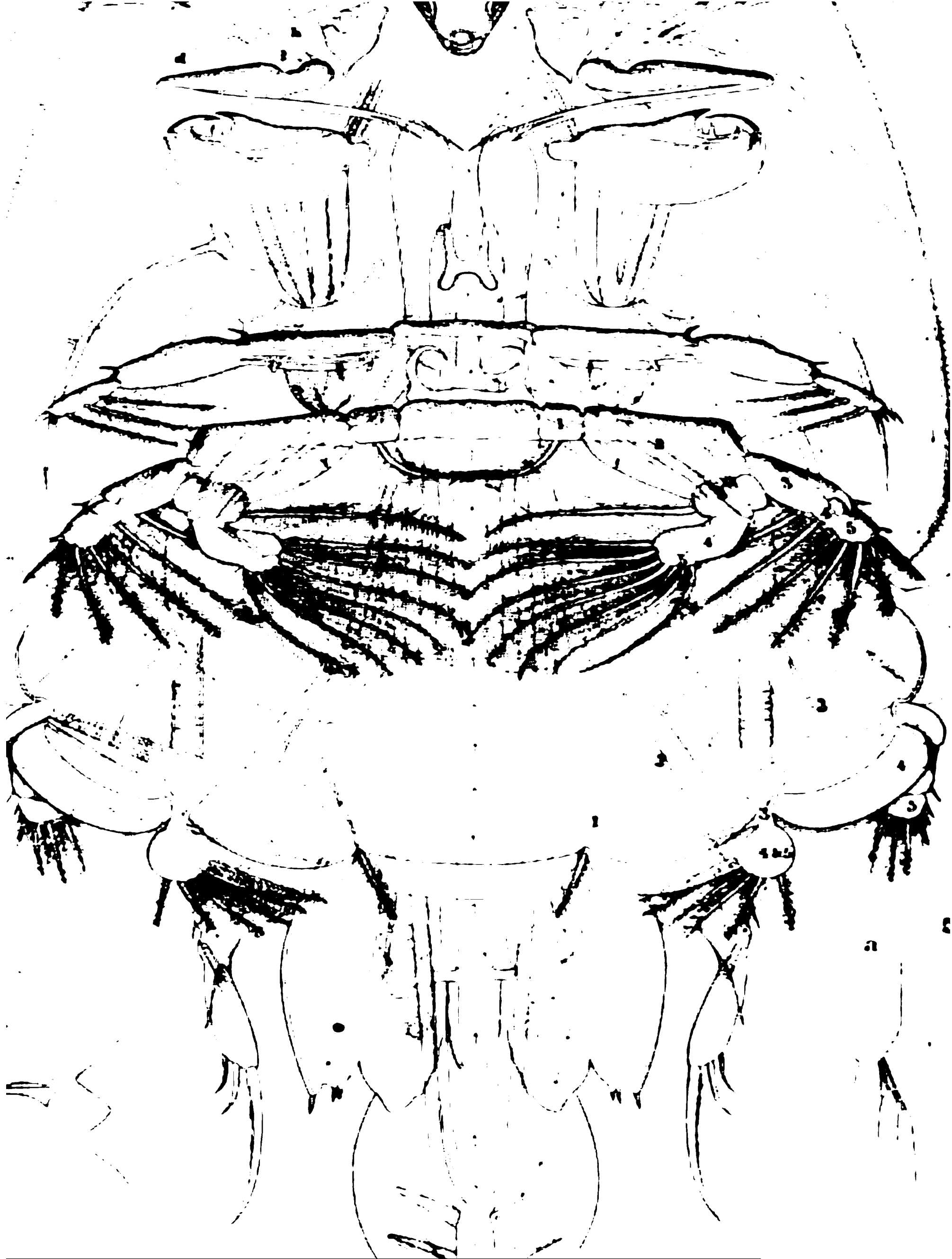

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# OF

# SCIENCE AND ARTS.

CONDUCTED BY

**BENJAMIN SILLIMAN, M. D. LL. D.**

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and For. Mem. Geol.
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# ERRATA.

Page 70, l. 12 fr. top, for *Lebois* read *Seboois*.—P. 72, l. 5 fr. bot. for *Kennebunk* read *Kennebeck*.—P. 204, l. 9 fr. top, for *Siberian*, read *Silurian*.—In a part of the impression, the drawing on p. 206 was accidentally inverted.

The writer of the article, "extracted from the Diary of a Naturalist," and published in the October number of the Journal for 1836, has since discovered several mistakes, which he wishes to correct. On page 1 it is stated, that the "first steamboat built on the western waters was the Washington"—he has since ascertained that a small boat was built some years before at Brownsville, and went down the river, but did not return: the Washington was built at Wheeling, Va. On page 64 it is stated, that Cols. Williamson and Crawford were engaged in the massacre of the Christian Indians at Gnadenhutten, which is a mistake as regards Col. Crawford, and probably arose from the fact of his being engaged with Col. Williamson in the affair at Sandusky plains in May following, where he lost his life. Colonel Crawford was a humane and excellent man, and abhorred that wicked transaction. The "legend of Brady's hill," at page 20, he is sorry to say, he fears has been confounded with some other adventure, as Capt. Brady's descendants affirm that he was never a prisoner to the Indians.

*Feb.* 2, 1838.

# NOTICE.

### TO OUR READERS AND FRIENDS.

Since the name of my son now appears for the first time, as assistant Editor of this Journal, I beg leave to mention him in that character, while I indulge a hope that he will endeavor, in that relation, as well as all others, to recommend himself to the confidence of the wise and good. More it is not necessary to say; and it remains to be seen, how far he will honor the trust thus reposed in him, in reference to the editorial and professional duties to which he is now devoted.

B. Silliman.

New Haven, April, 1838.

## ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

*Remarks.*—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from us, that we may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still our endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Eds.*

### DOMESTIC.

Remarks of Mr. Calhoun in Senate U. States on the bill authorizing an issue of Treasury Notes, Sept. 19, 1837. From Hon. J. C. Calhoun.

Speech of Hon. John C. Calhoun on the separation of the Government from the Banks, in Senate, October 3, 1837. Hon. J. C. Calhoun.

Catalogue of Poughkeepsie Collegiate School, with a figure of a Trilobite. From George L. Le Row.

Jewett's Advertiser, Medical and Scientific, No. 4. Vol. III. Oct. 1837. From the Editor.

Introductory Lecture at the opening of the Lancaster Conservatory, by and from Rev. C. Fr. Cruse.

Notice of the Indian copy of the Hebrew Pentateuch.

Letter No. X. to Am. Teachers on the Lyceum System of Education. Josiah Holbrook.

Dr. Barber's Elocutionist.

The Elements of Biblical Interpretation, by Rev. L. A. Sawyer.

Memoirs of Miss Mary Lyon. The three last from A. H. Maltby, the publisher.

Catalogue of the Library of the Linonian Society of Yale College. From L. T. Downing.

The Spirit's Life, a Poem. From the Author, Rev. Ray Palmer.

A Monograph of the Helices of the United States, by Amos Binney, M. D., M. B. N. H. Soc. &c. From the Author.

Ogdensburgh Meteorological Notice, in a newspaper of Oct. 17, 1837.

Reports and other documents relating to the State Lunatic Asylum at Worcester, Mass. with a print, pp. 200; printed by order of the Senate. From the Superintendant, Dr. S. B. Woodward. Two copies.

Historical Collections of New Hampshire, part 5. From Concord, N. H. 1637. From J. B. Moore, Librarian of the Society. Two copies, one for Y. Col. Library.

Documents relating to an attack by a British Squadron, upon the armed Brig General Armstrong, in the Island of Fayal, Sept. 26, 1814. From her late commander, S. C. Reid. Troy Budget, Oct. 31, 1837.

American Association for the supply of Teachers, 1837. From Jos. H. Dulles. Six copies.

Report on the Auburn and Rochester Rail Road, by Robert Higham, Engineer. From Henry Tracy, Canandaigua.

Scioto Gazette, Oct. 26, 1837, with notice of very large bones of a Mastodon. J. Hughes, Jackson C. H., Oct. 21, 1837.

Courier and Enquirer, of New York, Nov. 13, 1837—State Election Returns.

Portsmouth Times, Nov. 16, 1837—Aurora.

Am. Soc. for Diffusion of Useful Knowledge, Pros. for Am. Lib. for Schools and Families.

Buffalo Daily Com. Advertiser, several in Nov., containing Notices of Meteoric Phenomena. From R. W. Haskins.

Catalogue of the Golden Branch of Phillips' Exeter Academy, 1837. From the Society.

Poughkeepsie Telegraph, Nov. 22, 1837, with notice and drawing of a Trilobite. From G. L. Le Row.

An Address delivered before the Springfield High School, Ohio, Sept. 1837, by and from John H. James.

Introductory Letter, delivered before the Medical Class of the University of Maryland, Nov. 1837, by Sam. G. Baker, M. D. From the Author.

Annual Announcement of the Trustees and Faculty of the Medical College of South Carolina, for the session of 1837–38. From Prof. C. U. Shepard.

Extracts from Correspondence of the American Bible Society, Nov. 1837.

An Address delivered before the Mass. Charitable Mechanics' Association, Sept. 20, 1837, by his Ex. Gov. Ed. Everett. From the Author.

Portsmouth (Va.) Times, Dec. 2, 1837—Notice of an Aurora. Hd. Rodriguez.

Papers on the Wyoming Claims on the United States Government. J. W. Robinson.

Pennsylvania Intelligencer, Dec. 7, with the Governor's Message. J. W. Robinson.

Cheiroptera of the United States, by Wm. Cooper, with a plate, from the Annals of the Lyceum of Natural History. From the Author.

Journal of the American Temperance Union, Dec. 1837.

Catalogue of Princeton Theol. Seminary, for 1837–8. From E. P. Rogers.

Report of the State Treasurer of Pennsylvania, 1837. From J. W. Robinson.

Catalogue of Plants near Newbern, N. C.—with Remarks and Synonyms, by the late H. B. Croom, Esq., posthumous. From the Editor, Prof. John Torrey.

Twelfth Annual Report of the Board of Managers of Prison Discipline Society, Boston, 1837.

An Essay on the Veterinary Art, by Peter O. Browne, LL. D. 1837. From the Author.

Annals of the Lyceum of Nat. History, Vol. IV. Nos. 1, 2, 3 and 4, Nov. 1837.

Catalogue of French Medical, Mathematical, &c. Books, for sale, Dec. 16, 1837. Boston.

Report on the Strength of Materials, by the Franklin Institute. Part II. 1837. Hon. J. J. Whittelsey, M. C.

Farmer's Register, Dec. 1, et seq. 1837. Petersburgh, Va.

Speech on behalf of the University of Nashville, Oct. 4, 1837, at the public commencement, by President Lindsley.

Rev. Thomas Smyth's Sermon on the loss of the Steam Packet Home, with a Narrative.

New York Daily Whig. Several Nos.

Franklin Farmer, Frankfort, Ky. Several Nos.

Clinical Lecture on the Primary Treatment of Injuries, by Dr. Alex. H. Stevens.

Ordnung des taglichen Morgen Gebetes, &c. New York.

Circular of the College of Physicians and Surgeons of the Univ. of New York. 1837.

Colonization Herald and General Register, Vol. I. No. 1 and 2. Jan. 3 and 10.

Catalogue of Catlin's Indian Gallery of Portraits, Landscapes, Manners and Customs, &c. New York, 1837. From Mr. Catlin.

Catalogue of the Western Reserve College, 1836–7.

Literary Advertiser of the American Stationers' Company, Boston. July, 1837.

Daily Commercial Bulletin of Pittsburgh. Jan. 1838. From Linton Rogers.

Tract Magazine. Jan. 1838. From O. Eastman.

South Western Journal, Vol. I. No. 1. quarto, 16 pages, et seq.

Geological Reconnaissance of the State of Indiana in 1837, by D. D. Owen, State Geologist. From Prof. Dunn.

Report of the Commissioner of Patents for 1837. From the Superintendent, H. W. Ellsworth, Esq.

Prof. Cunningham's Inaugural Address, Easton, Penn. Jan. 1, 1838.

Report on the Medical College of Ohio, Dec. 1837. Dr. J. P. Kirtland.

Buffalo Daily Advertiser, Jan. 30, 1838. R. W. Haskins.

Rev. President Day on the Self-determining Power of the Will and Contingent Volition. From the Author.

Four Years in Great Britain, by Rev. Calvin Colton. From the Author.

Report of the Committee on Colleges, Academies and Common Schools, on the Memorial of William G. Griffin and others. From B. D. Silliman, Esq.

Proceedings of the Annual Convention of Professional Teachers and others, Columbus, Ohio, Dec. 1837. From M. G. Williams.

Fourth Geological Report to the Legislature of Tennessee, Oct. 1837, by Prof. G. Troost, M. D., Geologist to the State, &c. &c. From the Author.

Notice of the Academy of Natural Sciences of Philadelphia. 1837. p. 24. Dr. S. G. Morton. With one for the Yale Nat. Hist. Soc.

Penn. Inquirer, Feb. 24, 1838, with the Address of Hon. J. S. Buckingham on Temperance.

Buffalo Commercial Advertiser, No. 971; Do. No. 55, with notice of Falling Stars. R. W. Haskins.

Report to the Legislature of Ohio, Dec. 10, 1837, on Elementary Public Instruction in Europe, by Prof. C. E. Stowe. From the Author.

Considerations on a States' National Bank, by John L. Sullivan, A. M. From the Author.

Prospectus of the Missouri Iron Company, with the Acts of Incorporation. Rev. Giles Pease.

Boston Daily Advertiser, March 13, 1838, with a Memoir of the late Dr. N. Bowditch.

Buffalo Newspapers, with a list of Scientific Memoranda, translated from the Proceedings of the French Academy, by R. W. Haskins.

Discourse on the recent Duel in Washington, by Rev. Henry Ware, Jr.

On the same, by Rev. W. B. Sprague, D. D. Albany.

An Address on the Utility of Astronomy, delivered before the Young Men's Society of Lynchburgh, Va., by Prof. Landon C. Garland, of Randolph Macon College.

First Annual Report on the Geological Survey of the State of Ohio, by W. W. Mather, and the several Assistants. Columbus, 1838. Two copies from the corps; one copy from Mr. Seabury Ford.

Sixth Annual Report of the New England Institution for the Education of the Blind. From Dr. Saml. G. Howe.

Fifth Annual Report of the Trustees of the State Lunatic Hospital at Worcester, Dec. 1837. From the Superintendant, Doctor Samuel B. Woodward.

Second Report of the Executive Committee of Young Men's Association of the City of Buffalo. R. W. Haskins.

Macon Messenger, March 8, 1838, with a notice of the Thundering Spring.

Prospectus of the W. Virginia Iron Mining and Manufacturing Co. F. Shepherd.

Address delivered before the Bellefonte Lyceum, Feb. 1838.

Colonization Herald, Vol. I. No. 2. March 14, 1838. Philadelphia. 5 copies, 1 from Mr. Elliot Cresson.

Report of the State Geologist to Gov. Mason of Michigan, on the Geological Survey of that State.

Outlines of Geology, prepared for the Junior Class in Columbia College, by Prof. Jas. Renwick, LL. D.

Second Annual Report on the Geological Exploration of the State of Pennsylvania, by Prof. Henry D. Rogers. From Mr. Ritner. Another copy from Prof. H. D. Rogers; another from an unknown hand; another from E. Miner, Esq.

A Discourse on the Traffic in Spirituous Liquors, Feb. 1838. By Rev. Leonard Bacon, New Haven.

Statistical Tables of certain branches of Industry in Massachusetts, for 1837 to April 1. From John P. Bigelow, Esq., Secretary of the Commonwealth.

Report of the Committee on the Judiciary in the Legislature of New York. March 18, 1838. From B. D. Silliman, Esq.

Cleaveland Gazette, March 3, 1838, notice of ice.

Wiley and Putnam's notice of new books.

Temperance Circular, March 22, 1838.

Prof. White's and John T. Norton's Sermon on the occasion of the decease of John Nitchie, Esq. New York, 1838. From the Secretaries of the A. H. M. S.

Picture of Young Ladies, from the Society Seminary at Bethlehem, Penn. From G. Grunewald, by Col. Trumbull.

Catalogue of Bacon Academy, 1837. From M. N. Morris.

Dr. Geddings' Introductory Lecture, Medical College of South Carolina. Charleston, Nov. 1837. From H. H. Bacot.

Journal of American Temperance Union, vol. ii. No. 1.

Buffalo Patriot, &c., Jan. 10, 1837, with a Map of Navy Island, Niagara River, &c. From G. L. Marvin.

Boston Atlas, Aug. 2, 1837.

Annual Report of the Commissioners of Indian Affairs for 1837–8. Transmitted at the opening of the 2d session of the 25th Congress. Washington. From Charles E. Mix.

New Hampshire Patriot, &c., Aug. 2, 1837.

Medical Examiner, Philadelphia, No. 1, Vol. 1. Jan. 3, 1838. J. B. Biddle, M. D. and M. Clymer, M. D.

Seventeenth Annual Report of the Mercantile Library Association. Clinton Hall, New York, 1837.

Extracts from the Correspondence of the American Bible Society, Nos. 21 and 22. March, 1838.

First Report on the Agriculture of Massachusetts. By H. Colman, Commissioner. Boston, 1838. The Author.

Treatise on Bone Manure. By Henry Colman, Commissioner for the Agricultural Survey of Massachusetts. Boston, 1838. The Author.

On the Culture of Spring Wheat. By the same. From the Author.

### FOREIGN.

Liverpool Mercury, Sept. 15, 1837, containing an account of the doings of the British Association for the promotion of Science. From Rev. S. Wood.

Notice of the Scientific Congress at Metz, Sept. 3, 1837.

Circular of Louis and Andrè Breton, Mathematical and Philosophical Instrument Makers, Rue Servandoni, No. 4, pres St. Sulpice, Paris.

Liverpool Standard, Sept. 15, 1837; with an account of the doings of the British Association for the advancement of Science. From Rev. S. Wood. The same from Mr. St. John, late a tutor in Yale College.

Report on the Present State of our Knowledge with respect to Mineral and Thermal Waters, by and from Prof. Charles Daubeny, of the University of Oxford, England. 1837.

On the action of Light upon Plants, and of Plants upon the Atmosphere. Id. 1836.

Some account of the Eruption of Vesuvius, which occurred in Aug. 1834. Id. 1835.

On the quantity and quality of the gases disengaged from the Thermal Spring, which supplies the King's Bath, in the city of Bath. Id. 1834.

Catalogue of Philosophical Apparatus, by Wilkins & Hall. London, No. 5, Charing Cross. From J. H.

Remarks upon the Aristotelian and Platonic Ethics, as a branch of the studies of the University of Oxford, by Frederick Oakley, M. A., Fellow of Baliol College.

The study of Morals vindicated and recommended, in a sermon preached before the University of Oxford, Feb. 5, 1837, by Henry Arthur Woodhouse, B. D., Fellow of St. John's College. The two preceding from Mr. Charles Fox.

List of Works by American authors, on sale by Jas. S. Hodson, 112, Fleet street, London. From J. S. H.

Memorials of Oxford, England, No. 39, with Plates. From Prof. Daubeny.

Proceedings of the Geological Society of London. Nos. 50 and 51. From the Society.

Prospectus of the Polytechnic University, London. John Isaac Hawkins.

Foreign Scientific Memoirs—notice of a republication of a selection of, by Richard Taylor, F. S. A.

Catalogue of British Plants, arranged according to the natural system, &c. &c., by Rev. Prof. J. S. Henslow, M. A., of Cambridge University, England. From the Author.

Researches into the Causes of Voltaic Electricity, by Mons. Aug. de la Rive, of Geneva. From the Author.

Icones Filicum, or Figures and Descriptions of Ferns, principally of such as have been altogether unnoticed by Botanists, or have not yet been correctly figured. By William Jackson Hooker, LL. D. and Robert Kaye Greville, LL. D. In two volumes folio. Londini, 1831.

British Jaugermauniae; being a history and description, with colored figures, of each species of the Genus, and Microscopical Analyses of the parts. By William Jackson Hooker, LL. D. London, 1816. Quarto, 88 Plates.

Musci Exotici, containing figures and descriptions of new or little known Foreign Mosses, and other Cryptogamic subjects. By William Jackson Hooker, F. R. A., LL. D., &c. &c. London, 1818. 2 vols. 8vo.

Icones Plantarum, or figures and descriptions of new or rare Plants, selected from the Author's Herbarium. By Sir William Jackson Hooker, K. B., LL. D., &c. &c. 3 Parts, octavo, each containing 50 Plates. London, 1836–7.

Journal of Botany, by Sir William J. Hooker, LL. D., &c. &c. London, 1834. 4 Parts.

Companion to the Botanical Magazine. London. Nos. 1 to 20. By Sir W. J. Hooker, LL. D., &c. This and the five preceding it are from the Author.

Edinburgh Evening Courant, of Dec. 25, 1837, with a notice of the presentation of a silver vase to John Wood, Esq., Advocate, on account of his exertions in the cause of education.

Sussex Advertiser, England, Jan. 8, 1838. Brighton Herald, Jan. 20, 1838. Dr. Mantell.

British Annual, and Epitome of the Progress of Science, for 1838. From the Editor, Dr. Robert D. Thompson, London.

Notice of the University of Durham, Eng. From an English Newspaper.

List of the Geological Society of London. April, 1837.

Letters from Rev. Samuel Wood on the United States. Nos. 1 and 2. London, Nov. 1837. From the Author.

## MINERALS.

A box, containing chiefly chalk fossils, echini, bivalve and univalve shells, sharks' teeth and palates, and other remains of fishes, sponges, alcyonia, fuci, coprolites, belemnites, &c. From the Wealden—emys, iguanodon bones, &c. &c. From the tertiary—bones and teeth of the horse. From the diluvial—bog iron ore. Wood, from the peat bogs of Ireland—the submerged forests, coal plants. From Dr. G. Mantell, Brighton, Eng.

Very perfect and beautiful terebratulites and fossil corals—shore of Lake Erie, fifteen miles from Buffalo. G. E. Hayes.

Specimens of marl from New Jersey. From J. M. Ely, Esq., New York.

Fossil equisetum, in sandstone—large and distinct, from the excavations for the Walhouding and Mohican Canal, at Roscoe, Ohio. From J. S. Peters, Esq.

Specimens of bituminous coal, from New Lisbon, Ohio—remarkably filled with vegetable remains in flattened masses, having a distinctly fibrous structure. From Wm. E. Russell, Esq.

Lignite of remarkable beauty, from New Jersey. Dr. L. D. Gale, New York University.

## ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

*Remarks.*—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from us, that we may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still our endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Eds.*

### DOMESTIC.

Report of the case of Dartmouth College vs. Wm. Woodward. 8vo. pp. 406. By T. Farrar, Esq. From Rev. Dr. Lord, President of Dartmouth College.

Mr. Webster's Speeches, March 12th and 22d, in U. S. Senate. From Mr. E. Curtiss, M. H. Rep.

Annual Circular of the Medical College of Louisiana.

Annual Report of the Geologist of Maryland. 1837. From J. T. Ducatel, state geologist.

Otis, Broaders & Co. Catalogue of Periodicals for 1838.

Second Annual Report of the Geological Survey of the State of New York. (Assembly, No. 200.) Five copies: one from B. D. Silliman, Esq., one from T. A. Conrad, two from E. Emmons, and one from J. Hall.

Report on Fishes and Reptiles in the State of Massachusetts, by Dr. D. H. Storer. From the author.

Introductory Lecture to a course of Chemistry, delivered in Washington College, Lexington, Va., Feb. 21st, 1838, by G. D. Armstrong, A. M. From the author.

E. O. Kendall's formula for the announcement of the principal phases of the annular eclipse of the sun, Sept. 18th, 1838, by S. C. Walker, Esq. From the author.

Annual Report of the Regents of the University, March 1st, 1838. (Senate of New York, No. 52.) From B. D. Silliman, Esq.

Mr. Webster's Speech in answer to Mr. Calhoun, and on the sub-treasury bill; 3 copies. From Edward Curtiss, Esq., H. R.

Sermon on the anniversary of ordination, by J. Brazier. 1837. Salem, Mass. From Rev. J. Brazier.

Catalogue of Bowdoin College, Brunswick, Me. 1838. From Prof. P. Cleaveland.

Letters from the United States, by the Rev. S. Wood. Eng. From M. W.

Second Annual Report of the Geology of the public lands of Massachusetts and Maine, by Chas. T. Jackson, M. D. Boston. 1838.

Prodromus of a Practical Treatise on the Mathematical Arts, containing directions for Surveying and Engineéring, by Amos Eaton, A. B. and A. M. 8vo. Troy, N. Y. 1838. From the author.

Travels on the continent of Europe, by Wilbur Fisk, D. D. With engravings. (Third edition.) New York. 1838. Harper and Brothers.

Report to the U. S. Senate, March 12th, 1838, on the introduction of tropical plants into Florida, and the south and southwestern states. From H. Perrine. Washington. Accompanied by specimens of coarse and fine foliaceous fibers of the Musa Abaca, Agave Sisalana, and Bromelia picta.

An Elementary Treatise on Algebra, theoretical and practical, &c., by Prof. J. R. Young, of the Royal College, Belfast. A new American from the last London edition. Philadelphia. 1838. From the publishers, Messrs. Carey, Lea & Blanchard.

Commentary on Genesis, by Prof. Bush. New York University. From the editor.

First Annual Report on the Geological Survey of Ohio. From W. W. Mather, principal geologist.

Cholera Infantum, its causes and treatment, by David King, Jr., M. D. Boston. 1837. From the author.

An Address before the Dorchester Agricultural Society, Nov. 1837, by Joseph E. Muse. From the author.

Exposition of a new theory of Animal Magnetism, &c., by C. F. Durant. New York. 1837.

Extracts from correspondence of American Bible Society. January. 1838.

Discourse before the Massachusetts Horticultural Society, by J. L. Russel. Boston. 1835.

The Napolead, in 12 books, by Th. H. Gerine, Esq., to the public library in New Haven.

First Annual Report of the board of education, &c. No. 26. Senate of Massachusetts. Boston. 1838. From Horace Mann.

The same. From E. Davis.

Report of the secretary of the board of education on the subject of School Houses, &c. Boston. 1838. E. Davies.

The same. From H. Mann.

A Discourse on the life and character of Nathl. Bowditch, LL. D. F. R. S. Boston. 1838. From the author, Rev. Alex. Young. A second copy from Isaac P. Davis, Esq.

Eulogium on the life and character of the Hon. Nathaniel Bowditch, by Hon. Judge White, of Salem. From the author.

Nineteenth Annual Report of the Directors of the New York Institution for the Deaf and Dumb. New York. 1838. From H. P. Peat, principal.

*American* Journal of Pharmacy. January, 1838.

Annual Report of the Colonization Society of the city of New York. 1838.

Speech of Gov. W. W. Ellsworth, May, 1838, to the Legislature of Connecticut.

Document No. 121, U. S. Government, containing observations on the tides near the northern extremity of Cape Cod, Mass., by and from James D. Graham,—two copies, one for Yale College library.

Engraved Portrait of Rev. Jonathan Edwards, usually called the first. From I. P. Davis, Esq. Boston.

Do. of John Winthrop, Governor of Massachusetts colony.

Do. Do. Do. of Connecticut. The two latter for Yale College. From I. P. Davis, Esq. Boston.

Colored lithograph portrait of the Indian chief Osceola. From Geo. Catlin, Esq., the artist, through D. Macumber.

An Essay on the relation between the respiratory and circulating functions, by Charles Hooker, M. D. of New Haven. Boston. 1838. From the author.

*Charter* and by-laws of the Maryland Academy of the Fine Arts. *Baltimore*. 1838.

Atlantic Steam Ships, &c. From Ithiel Town, Esq.

Cheever's Latin Accidence; recommendations of the work, and a biographical notice of the author. Boston. 1835.

Report of Mr. Talmadge in the Senate of the United States, on the memorial of Henry Hall Sherwood, claiming to have made important discoveries in magnetism, &c. From Mr. C. Cushing, M. C.

## FOREIGN.

Practical observations on the Asphaltic Mastic, or cement of Seyssel, &c. London. 1837.

The country of the Iguanodon restored, by John Martin, Esq., from geological discoveries of Gideon Mantell, Esq., LL. D. F.R.S. &c.; two beautiful prints. From Dr. Mantell.

Two engraved portraits of Dr. Mantell.

Handbuch der Oryktognosie von Carl Cæsar von Leonhard; professor, &c. Heidelberg, Germany.

Hawaiian Spectator. Vol. I. No. 1. January, 1838. Honolulu, Oahu, Sandwich Islands.

India Review and Journal of Foreign Science and Arts. Edited by Frederick Corbyne, Esq. Calcutta. 15 Nos. from the Editor, through J. V. C. Smith, Esq., Boston, by Capt. Wiley, S. Frank.

The Sixth Report of the British Association for the Advancement of Science. Vol. V. From the Association.

Laws and Regulations of the Meteorological Society, instituted in 1833. London. 1838. From the Society.

Observations made during 37 successive hours, commencing at 6 A. M. of the 21st of March, 1838, and ending 6 P. M. of the 22d.

S. Maynard's Catalogue of English and Foreign Mathematical books. London. J. S. Hodson.

Bulletin de la Société Française de Statistique Universelle, Livraison 1, 2, 3, 6, and documens No. 8. 1830–31.

Annals of Electricity, Magnetism, and Chemistry, &c., by Wm. Sturgeon. January, 1838. No. 2.

Select Views in Greece, with classical illustrations, by H. W. Williams, Esq., F. R. S. E. Lond. 1829. In two volumes largest royal 8vo., superbly bound, and containing sixty-four splendid engravings of scenes in Greece—the classical illustrations and their translations from John Patterson. Edinb. Presented to the Trumbull Picture Gallery of Yale College, by John Dunlop,* Esq. of the city of Edinburgh.

Wonders of Geology, 2 vols. 12mo., with numerous plates and wood cuts, by Gideon Mantell, LL. D. F. R. S., &c. Lond. 1838.

Oratio in Academia Fridericiana Halensi cum Vitebergensi consociata, &c. October, 1831. Habita ab Prof. J. S. C. Schweigger. Phil. Soc. &c. &c. &c. From the author.

The following is the peroration: " Vir per-illustris,—qui legatum summi rerum nostrarum administri agens nobis ædes academicas tradidisti: Magnificè Academiæ protector; Per-illustris Director; viri summe reverendi, per-illustres, illustres, amplissimi, doctissimi; auditores omnium ordinum honoratissimi."

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* Mr. Dunlop has travelled extensively in this country, and is well known for his acts of munificence and benevolence.

Ueber die Natur der Sonne mit Beziehung, auf V. Sæmmeorrings Sonnbeobachtungen. Vom Dr. J. S. C. Schweigger, Prof. der Physik und Chemie, &c. &c. Halle. 1829.

Statuten der Naturhistorischen Gesellschaft, zu Athen.

Ueber die alteste Physik und den Ursprung des Heidenthums aus einer missverstandener naturweisheit, &c. Von Dr. Schweigger.

Einleitung in die Mythologie auf dem Standpunkte der Naturwissenschaft. Von Dr. J. S. C. Schweigger.

Diploma from the Natural History Society in Athens, Greece.

A Popular Treatise on Voltaic Electricity and Electro-Magnetism, &c., by and from B. H. Bachhoffner, lecturer on chemistry, &c. &c. pp. 35. 1838.

Stenographic round-hand, by Isaac Pitman. London. 6 copies.

Rules of the London Electrical Society, with an address, delivered by Wm. Sturgeon, Esq. Aug. 7th, 1837, at the theatre, Adelaide street.

Memoirs published by the Society. Both the above from the Society, or Mr. Clarke, the Electro-Magnetician.

*Agenda Geognostica.* Von C. C. von Leonhard. Heidelberg, *Germany. 1829.* From W. C. Woodbridge.

Memoir on the bones of birds discovered in the strata of Tilgate Forest in Sussex, by Gideon Mantell, LL. D. F. R. S., &c., with a plate: 4 copies. From the author.

On the advantages of exercise in some spinal deviations, addressed to Sir B. C. Brodie, by Dr. Riofrey. London.

List of prices of magnetical, philosophical, optical, and chemical instruments and apparatus, manufactured by Edward M. Clarke, No. 11, Lowther Arcade. London.

List of chemical and philosophical apparatus, and chemical tests, manufactured and sold by E. Palmer, 103 Newgate street. Lond. 6 copies, with 6 cards.

Proceedings of the Geological Society of London. Nos. 41, 52, 53, 54 and 55. From the Society and from Dr. G. Mantell.

Prospectus of the Zoology of the ship Beagle. 1832 to 36.

Prospectus of Bryologia Europea seu Genera Muscorum Europærum monographice illustrata; auctoribus Bruch & W. P. Schrimper. 13 copies.

*Prospectus* de Le Muséum Zoologique de Heidelberg. 8 copies. The museum offers exchanges with foreign museums, via Hâvre en France, par Messrs. Warner, Langert & Co., or via Rotterdam en Hollande, surtout pour les objets fragiles. The director of the museum is Prof. H. G. Bronn.

The prospectus makes known the conditions, and we will forward them if desired.—*Ed. Am. Jour.*

Prospectus of an Institution for the advancement of the Arts and Practical Science. London.

Brighton (Eng.) Herald. No. 1683. Containing a notice of Dr. Mantell's Wonders of Geology.

Mining Review, an entire bound copy, for the Yale College Library. Henry English, Esq. London.

## *American Newspapers.*

Elizabethton Republican, Tenn., various Nos.

Daily Nat. Intelligencer. Washington, March, 1838. Mr. Buckingham on duelling.

Boston Courier, May 20th, 1838. Mr. Buckingham's vindication.

Mohawk Courier, Little Falls, Feb. 15th, 1838. Notice of the American Journal.

Providence (R. I.) and Pawtucket Advertiser, May 31st, 1838. Notice of Geological Reports.

Cincinnati Journal, June 7th, 1838.

Albany Journal, Feb. 18th, 1838. Speeches in the New York legislature on the small bill law.

Newburgh Journal. J. D. Spalding, June 16th, 1838. Agency for periodical works.

Cleveland Gazette, May 23, 24, 26, and 28, 1838. Meteor and N. W. passage. Rise of water in the lakes. Question of vegetable origin of coal. It is not difficult to answer the writer's objections to the vegetable origin of coal, and to demonstrate that it certainly had that origin.

Mobile Examiner, April 20th, 1838.

Journal of the American Temperance Union. May, 1838.

Feliciana Republicana. Nos. 4 and 8. W. M. Carpenter, M. D.

Missouri Saturday News. Nos. 5 and 6. Anon.

Cincinnati Daily Gazette. No. 3319. From Dr. John Locke.

New York Journal of Commerce. No. 4188.

Buffalo Daily Commercial Advertiser. No. 1036, From Mr. R. W. Haskins.

Baltimore American, &c. No. 13965. From Mr. N. Hickman.

Cincinnati Daily Gazette, March 29th, 1838. Dr. Beecher's address to Mechanics.

Lancaster Herald, June 21st 1838. M. Ellmaker.

Circular of Josiah Holbrook on the Lyceum System of education.

Columbus Register, April 5th, 1838. Geological and Magnetical survey of Ohio.

Buffalo Advertiser, May 10th, 1838. Notice of the American Journal, No. 1 Vol. xxxiv. E. Haskins.

Gennessee Farmer, June 16th, 1838.

## *Library of Yale College.*

From Rev. President J. Adams, Charleston, S. C.

Sermon before the Protestant Episcopal Convention, Charleston, S. C., Feb. 13th, 1833.

Eulogium on Elias Horry, Esq., Charleston, Jan. 23d, 1838.

Sermon, Advent Sunday, on the day of the total eclipse of the sun, Nov. 30th, 1834.

Baccalaureate Address at the annual commencement, Charleston College, Nov. 3d, 1835.

Sermon, Advent Sunday, Charleston, Nov. 29th. 1835.

Address before the Euphradian Society, Charleston College, Oct. 30th, 1833.

Oration on the moral causes of the welfare of nations, Charleston College. Before the graduates, Nov. 1st, 1834.

Inaugural Discourse. Geneva, N. Y. Aug 1st, 1827.

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New Electro-Magnetic Instrument, from Dr. C. G. Page, Boston, and now of Washington, D. C.

Do. E. M. Clarke. London.

Large and splendid specimen of the Florida shell rock, from St. Eustatia Island, for Yale College Cabinet. From Mrs. Mary Wilkinson, late Miss Peters.

Do. of the sandstone of the Cattskill mountains, replete with terebratulæ, &c.

Beautiful polished marbles from Proctorsville, Vt., from Mr. Ilock Hills, proprietor.

Rich lead ore galena, St. Thomas, W. I. P. I. Minvielle.

Box of terebratulæ, trilobites, &c., from the vicinity of Buffalo. E. G. Hayes.

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Henry English, Esq. of London, Editor of the Mining Review and Mining Journal, has placed at the disposal of the Editors of this Journal the sum of twenty dollars, "to be given as a premium for the best paper on a subject intimately connected with mining pursuits, with drawings," to be inserted in this Journal.

### *To Proprietors of Land and others in Illinois and other Western States.*

A professional gentleman, travelling to the West, during the ensuing autumn and winter, and well acquainted with Geology, will be willing to undertake a geological investigation, and make a responsible report of any interest connected with the mineral kingdom, in any of the States contiguous to the Ohio river or the great lakes. His address and full information may be obtained from the editors of this Journal.

**New Haven, July 12, 1838.**

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

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## Art. I.—*Seventh Meeting of the British Association for the Advancement of Science.*

[Concluded from Vol. xxxiii. p. 296.]

*Waves.*—Mr. Russell had made in September, 1836, a series of observations on the River Dee, below Chester, where that river has a form and dimensions admirably suited to the purpose. It appears, that for more than five miles in length, the banks of the Dee are perfectly straight, quite parallel to one another, while the depth of the channel at low water is nearly uniform throughout the whole of that length. Now, in this river there is a tidal wave of from six to fifteen feet, forming, in fact, a tidal canal of large dimensions. On this part of the river the first series of observations was made; a second was made upon the River Clyde; and a third on the waves at the surface of the sea: and the series has been terminated by a course of experiments made in artificial channels of different forms, for the purpose of determining the nature of the mechanism of the generation and propagation of waves, so as to determine the identity of their nature with the tidal wave.

It appears that there exists a species of wave different from all the others, and which Mr. Russell calls "The Great Primary Wave of Translation," which is generated whenever an addition is made to the volume of a quiescent fluid, in such a manner as to affect simultaneously the whole depth of the fluid, and this species of wave is exactly of the same nature as the tide wave. In a rectangular channel this primary wave moves with the velocity which a heavy body would acquire in falling through half the depth of the fluid, so that

In a channel about 4 inches deep, the velocity of the wave is nearly 2 miles an hour.

| | | | | | |
|---|---|---|---|---|---|
| — | 12 | —— | —— | 4 | — |
| — | 2 feet deep | | —— | 5½ | — |
| — | 3 | —— | —— | 6½ | — |
| — | 4 | —— | —— | 7¾ | — |
| — | 5 | —— | —— | 8¾ | — |
| — | 6 | —— | —— | 9½ | — |
| — | 7 | —— | —— | 10 1-5th | — |
| — | 8 | —— | —— | 11 | — |
| — | 9 | —— | —— | 11½ | — |
| — | 10 | —— | —— | 12 1-5th | — |
| — | 15 | —— | —— | 15 | — |
| — | 30 | —— | —— | 20 | — |
| | &c. | | | &c. | |

It also appears that the breadth of the channel, when the depth is given, does not at all affect the velocity or form of the wave; and Mr. Russell then proceeded to assign a general rule, by means of which the velocity of the wave might be assigned *à priori* for a channel of any form, however irregular.

The manner in which the wave was observed, was by successive reflections from opposite surfaces, so as to make it pass and repass a given station of observation, the interval being noted by an accurate chronometer; and it was stated, that in many cases, above sixty transits of the same wave had been observed, so as to give a high degree of accuracy to the observations. The instant of the wave's transit had been observed by the reflection of a luminous image, thrown down by a series of mirrors, so as to cross micrometer wires with perfect precision. For a mode of determining the length of the wave, Mr. Russell acknowledged himself indebted to Prof. Stevelly, of Belfast.

These observations, having determined the laws of the propagation of waves on a small experimental scale, were then extended to the analogous phenomena of the great tidal wave. In his observations on the River Dee, Mr. Russell found that the tide wave followed precisely the same laws as those in his experimental channel; that its velocity was exactly proportioned to the square root of the depth of the fluid, that its form changed in the same manner, and the existence of the same law was sufficient to account for the different rate of propagation of different tides between two given places, because a tide of fifteen feet deep would travel from one place to another at the rate of fifteen miles an hour, while one of ten feet deep would proceed at the rate of only twelve miles an hour; so that if the places were thirty miles apart, the one would receive the former tide two hours later, and the latter tide two and a half hours later than the other. The creation of a tidal Bore in some places was also accounted for on the same principles; and it was evident, that the means of improving the navigation of tidal rivers might be satisfactorily deduced from these principles.

Similar observations had been made on the tidal wave of the River Clyde, which was found to move in strict conformity with the laws of the great wave of translation, as determined by Mr. Russell's previous experiments.

*Magnetical Observatory at Dublin.*—The Magnetical Observatory now in progress at Dublin, is situated in an open space in the gardens of Trinity College, and sufficiently remote from all disturbing influences. The building is forty feet in length, by thirty in depth. It is constructed of the dark-colored argillaceous limestone, which abounds in the valley of Dublin, and which has been ascertained to be perfectly devoid of any influence on the needle. This is faced with Portland stone; and within, the walls are to be *studded*, to protect from cold and damp. No iron whatever will be used throughout the building. With reference to the materials, Prof. Lloyd mentioned, that in the course of the arrangements now making for the erection of a Magnetical Observatory at Greenwich, Mr. Airy had rejected bricks in the construction of the building, finding that they were in all cases magnetic, and sometimes even polar. Mr. Lloyd has since confirmed this observation, by the examination of specimens of bricks from various localities; and though there appeared to be great diversity in the amount of their action on the needle, he met with none entirely free from such influence.

The building consists of one principal room, and two smaller rooms,—one of which serves as a vestibule. The principal room is thirty-six feet in length, by sixteen in breadth, and has projections in its longer sides, which increase the breadth of the central part to twenty feet. This room will contain four principal instruments, suitably supported on stone pillars: viz. a transit instrument, a theodolite, a variation instrument, and a dipping circle. The transit instrument (four feet in focal length,) will be stationed close to the southern window of the room. In this position it will serve for the determination of the time; and a small trap-door in the ceiling will enable the observer to adjust it to the meridian. The theodolite will be situated toward the other end of the room, and its centre will be on the meridian line of the transit. The limb of the theodolite is twelve inches in diameter, and is read off by three verniers to ten seconds. Its telescope has a focal length of twenty inches, and is furnished with a micrometer reading to a single second, for the purpose of observing the *diurnal variation.*

The variation instrument will be placed in the magnetic meridian, with respect to the theodolite, the distance between these instruments being about seven feet. The needle is a rectangular bar, twelve inches long, suspended by parallel silk fibres, and inclosed in a box to protect it from the agitation of the air. The magnetic bar is furnished with an achromatic lens at one end, and a cross of wires at the other, after the principle of the collimator. This will be observed with the telescope of the theodolite, in the usual manner; and the deviation of the line of collimation of the collimator from the magnetic axis will be ascertained by reversal. The direction of the *magnetic* meridian being thus found, that of the true meridian will be given by the transit. It is only necessary to turn over the transit telescope, and, using it also as a collimator, to make a similar reading of its central wire, by the telescope of the theodolite. The angle read off on the limb of the theodolite is obviously the supplement of the variation. This use of the transit has been suggested by Dr. Robinson; and it is anticipated that much advantage will result from the circumstance, that the two extremities of the arc are observed by precisely the same instrumental means. With this apparatus it is intended to make observations of the *absolute variation* twice each day, as is done in the observatory of Prof. Gauss, at Göttingen,—the course of the *diurnal variation*, and the hours of maxima and minima, having been ascertained by a series of preliminary observations with the same instrument.

A dipping circle constructed by Gambey, will be placed on a pillar at the remote end of the room; and will be furnished with a needle, whose axis is formed into a knife-edge, for the purpose of observing the diurnal variations of the dip. Gauss's large apparatus will also be set up in the same room, and will be used occasionally, especially in observations of the *absolute intensity*, made according to the method proposed by that distinguished philosopher. The bars are too large to be employed in conjunction with other magnetical apparatus.

It is intended to combine a regular series of meteorological observations, with those on the direction and intensity of the terrestrial magnetic force just spoken of; and every care and precaution has been adopted in the construction of the instruments.

In conclusion, Mr. Lloyd said, that he felt it a duty to allude to the liberality and zeal in the cause of science, which had been evinced by the Board of Trinity College on this occasion. The probable expense of the building and instruments is estimated at 1000*l.*; and that sum was immediately allocated to the purpose, when it appeared that the interests of science were likely to be benefited by the outlay.

Mr. Peacock congratulated the Section upon the prospect held out to the scientific world, of having fixed magnetical observatories erected in such places as would afford the surest promise of successful co-operation, particularly when they would be placed under the superintendence of gentlemen so eminently qualified for the task as Prof. Lloyd. He informed the Section, that an observatory for magnetical observations had been erected at Greenwich, and that little doubt need be entertained of the rapid advances which the interesting investigations connected with this important science would now receive.—Mr. Ettrick conceived, that bricks would be a very improper material for the construction of a magnetical observatory. He considered the use of metals in any part of the building as highly objectionable; even copper, as fastenings, or hinges to doors, would not be free from injurious effect. He made some inquiries as to the mode of reading off, proposed by Prof. Lloyd.—Prof. Stevelly said, that Mr. Ettrick was unquestionably right in the objection urged against the use of bricks, but Prof. Lloyd had distinctly stated, that bricks were not to be used, and that experiments had been made to ascertain the precise magnetical influence, if any there was, of the kind of stone which it was proposed to use. It was well, however, that Mr. Ettrick's observations should go abroad, for the guidance of persons not conversant with these subjects. Bricks, when built into large edifices, such as the chimneys of factories, were well known to have acquired magnetic polarity: the material from which they were made must be largely impregnated with iron: the mud of rivers was the detritus from hills, whose rocks were often highly magnetic. The engineers employed on the trigonometrical survey of Ireland, had erected a mound of stones composed of basalt, to sustain the signal-staff which they had erected on the highest hill, near Belfast: the effect of that heap of stones on the magnetic needle was so great, that in walking round it, the needle would veer round to every point of the compass.

*Electro-Magnetic Currents.*—M. de la Rive then read a paper 'On the Interference of the Electro-magnetic Currents.' This distinguished foreigner addressed the Section in the French language. After a brief *résumé* of the known properties of electro-magnetic currents, he adverted to some new results at which he had arrived in studying them. He remarked, that in chemical decomposition effected by these currents, the *individual* force of each was greater the more rapidly they succeeded each other; so that, to decompose a given quantity of water, it becomes necessary to have a number of these currents, so much the greater as the succession is less rapid. There is, however, a limit, beyond which the force of the currents is not augmented by any further augmentation of the rapidity of the succession. When plates of platina are employed, instead of wires, in the decomposition of water, the decomposition ceases to take place when the surface of contact of the metal with the liquid surpasses a certain limit. Nevertheless, the current, far from diminishing in intensity, becomes, on the contrary, more intense,—as is shown by the indications of a metallic thermometer,—the helix of which, placed in the current, furnishes a measure of its calorific energy. As soon as the surfaces of contact are of such magnitude that decomposition is no longer effected, the thermometer reaches a maximum, which it does not pass, even when the surfaces of contact are augmented. This fact seems to prove, that chemical decomposition produced by electrical currents takes place only when these currents undergo a certain resistance in their passage from the metal into the liquid; and that, when this resistance does not exist, decomposition ceases. When we employ wires of platina to transmit the magneto-electric currents into a solution of any kind, whether acid, saline, or alkaline, we, at first, observe an abundant evolution of gas; then this disengagement diminishes, and at the end of fifteen or twenty minutes it altogether disappears. When we examine these metallic wires, we find them covered with a very fine powder, composed of platina in the metallic state, but extremely divided. The same phenomenon takes place with gold, palladium, silver, &c. All these metals are covered, in the same manner, with a very fine coating of the metal itself, in a state of extreme subdivision. The author has assured himself that this powder was composed of the metal itself, and not an oxide or a suboxide. He inquired whether this effect is the result of the mechanical shocks that the molecules of the metal undergo by the action of these currents, which are discontinuous, and alternately in opposite directions; and whether it would not be augmented by the succession of oxidations and deoxidations, which would occur on the surface of the wires. He concluded by stating, that he had observed that the armatures of soft iron (about which the metallic wires are coiled, in which the currents are developed by induction,) cease to be attracted by the poles of the magnets, before which they pass when the two ends of the wire in which the current is developed are united by one good metallic conductor; a fact which would seem to prove that Magnetism and Dynamical Electricity are, in these cases, but two different forms of the same force, one of which disappears when the other becomes apparent; and he insisted on the advantage that we might derive from this property in the production of motion by electro-magnets.

*Clearness of the Air.*—Prof. Lloyd said that the distinctness and vividness with which distant objects were seen in some states of the atmosphere was quite astonishing: on one occasion he had seen from the neighborhood of Dublin the Welsh hills from their very bases, and brought so near, apparently, that he could absolutely see the larger inequalities of the surface upon the sides of the mountains. That the atmosphere was at the time very much loaded with vapor in a highly transparent state, was obvious from the fact, that immediately after a very heavy fall of rain took place, and continued for a considerable time.—Prof. Stevelly wished to confirm what had fallen from Prof. Lloyd and M. de la Rive by stating that whenever the Scotch hills appeared with peculiar vividness and distinctness, from the Lough of Belfast, the fishermen always looked upon it as a sure precursor of heavy rain and wind. A friend had informed him that on one occasion he had noticed this appearance while standing on the beach at Hollywood, and pointed it out to an old fisherman; the old man immediately gave notice to all his friends to whom he had access, who instantly set about drawing up their boats and placing their small craft in more secure places; early the next morning a violent storm came on, which did much damage upon the coast, to those who had not been similarly forewarned. It might perhaps be accounted for by supposing that on these occasions the intervening air became actually converted into a large magnifying lens.

*Magnetic Intensity.*—Determinations of the value of the terrestrial intensity have been obtained at between forty and fifty widely scattered stations, principally in the southern hemisphere, where such determinations had been previously a great desideratum.

The number of separate determinations collected in this Report exceeds six hundred, and the number of stations falls a little short of five hundred. They are the work of twenty-one observers, and of these the observations of seven have been hitherto unpublished.

*Beer.*—Mr. Black communicated a paper 'On the Influence of Electricity on the processes of Brewing.' According to his statements, a thunder-storm not only checks the fermentation of worts, but even raises the gravity of the saccharine fluid, and developes in it an acid. This effect is witnessed principally when the fermenting tun is sunk in moist earth, and may be obviated by placing it upon baked wooden bearers, resting upon dry bricks or wooden piers, so as to effect its insulation. Mr. Black also stated, that during the prevalence of highly-electrified clouds, the fabrication of cast iron does not succeed so well as in other states of the atmosphere.

*Electrical Relations.*—Dr. Faraday cautioned chemists against considering electrical relations as affording, in every instance, conclusive proofs of what is a base and what is an acid.

*Electrical Protection.*—A letter was next read, addressed by Mr. Locke to Mr. W. W. Currie, of Liverpool, in which the latter was requested to propose as a question, to the philosophers assembled, whether, in the case of a monument one hundred and forty feet in height, erected on the summit of a mountain fourteen hundred feet high, augmented safety or danger would be the consequence of attaching to it a conductor or paratonnerre. The column is sandstone, the mountain conglomerate, and in the vicinity of the latter there is a mountain of still greater elevation. It was resolved, that this letter should be, *pro formâ*, put into the hands of Mr. Snow Harris, though no doubt whatever was felt as to the answer which it would be proper to give to such an inquiry. The efficacy of the protectors of Franklin in every possible situation, provided they be constructed upon proper principles, and mounted in a suitable manner, is now universally admitted.

*Mining.*—Mr. Tarlor, jun., stated, that, in the course of his experience in practical mining, he had observed certain conditions necessary for the profitable working of metals. In the oldest, or scar limestone, he had observed that the miner was not remunerated; but in newer lead measures he had a better chance of success, as in grits and shales. The best chance was in altered rocks. In Cardiganshire he had observed a remarkable case in a slaty rock: where very schistose, the workings were poor; but where the rock was *diced*, as the workmen call it, they were certain to be rich: the strike of the altered rock being N. and S., and that of the veins E. and W. He had seen remarkable proofs of the mechanical theory in North Carolina, especially in the rich veins of iron ore in that country. Mr. Sedgwick remarked, that fissures caused by crystallization were, in general, very small; and that joints seldom coincided with rents;—that in districts where granite approaches slate rocks, we may be certain of finding the richest metalliferous deposits.

*Catastrophe in a Mine.*—Mr. Sedgwick requested the attention of the meeting to an account, which he was about to submit, of the late unfortunate accident at the Workington Colleries. He pointed out, on the geological map, the rocks which occur in that neighborhood, and stated some of the phenomena of the stratification of the coal measures, which are there very much disturbed. There is an anticlinal line, on the opposite sides of which the strata dip differently, so that, in one place, very important beds of coal crop out under the sea. Workings, quite submarine, have accordingly been carried on for some time: in the Isabella pit, a depth of one hundred and thirty-five fathoms under high water has been reached. A culpable want of caution has been shown by the managers of late, as they have caused the workings to reach too near the sea—even within fourteen fathoms of it; and the pillars and roof of the older works had been taken away, by which the danger was greatly increased. There had been repeated warnings from the shrinking of the ground, and from an old work having become filled with water;—also in the new workings—although the pumping brought up one thousand gallons per minute, the miners were in such danger of being drowned, that several left the employment. In the latter end of July, the sea at length broke in, filling the mine in all its parts, in little more than two hours, and destroying twenty miles of railway. On one side of the Camperdown dyke, which ranges through the mine, not a soul was saved, but several escaped from other parts; and one individual, an Irishman, called Brennagh, had not only a remarkable escape himself, but saved three others by his intrepidity. Prof. Sedgwick related to the Section this man's story, which was so singular, and told with such a mixture of the serious and ludicrous—often in the language of the man himself—that it is impossible to convey to the reader an idea of the effect produced on the audience. A remarkable fact in the escape of one of the individuals rescued by Brennagh was, that he was actually *blown up* the last open shaft of the mine by the enormous force of the air, the noise of which was heard at a considerable distance in the country. The first notice to Brennagh of the accident, was an unusual undulation of air in the galleries, which made him suspect that all was not right, and he took the precaution of moving near to an air passage in the dyke, which he had been permitted to use: he was thus enabled to save himself and his companions. At the suggestion of the Professor, a subscription was made in the Section for Brennagh, which amounted to 34*l*.

*Intestinal Worms.*—Dr. Richardson communicated a paper from Dr. Bellingham, on the frequency of the occurrence of *Trichocephalus dispar* in the alimentary canal. The author alluded to the difficulty of accounting for the origin of animalculæ in the human body. To say that they were secreted or not secreted by the tissues of the body, was premature, as we knew so little of secretion itself. Although in some instances parasitic animals produced injurious consequences to the animal they infested, yet in many others no injury was experienced. The Trichocephalus was found in the majority of human beings, but produced no ill consequences. The genus belonged to the division *Nematoidea* of Rudolphi, and contained eight species. The *Trichocephalus dispar* was mostly found in the cæcum, but sometimes occupied the colon and small intestines. It had been found at Göttingen in those who died of fever, and at Naples in those who died of cholera; and was there supposed to be the cause of that frightful disease. Baillie and Bostock had stated it to be rare, whilst French and German anatomists had pronounced it frequent in the generality of the human species. The author states, from his own experience, that out of twenty-eight individuals he had opened, who had died of various diseases, and varied in age and sex—the youngest being fourteen—he had found the *Trichocephalus dispar* in twenty-five. Dr. Richardson added, that in the lower mammalia and in fish, the cæca were frequently found filled, in some literally crammed with Botryocephali, ranging from a yard to a yard and a half in length; and what was remarkable, the animals appeared to be as healthy and vigorous as if they were not infested.

*Plants growing under Glass.*—In April last, Dr. Daubeny introduced into globular glass vessels, their aperture being covered with bladders, three several sets of plants. In the first were *Sedum*, *Lobelia*, &c.; in the second, *Primula*, *Alchemilla*, &c.; in the third, *Armeria*, *Sempervivum*, &c. At the end of ten days the plants were healthy, and had grown. The air in the jars was examined, when it was found that the first had four per cent. more oxygen than the atmosphere, the second also four per cent. more, and the third one per cent. more. This was the result of examination during the day, but at night the excess of oxygen had disappeared. On the eleventh day, the first jar contained two per cent., the second and third one per cent. excess of oxygen. At night there was less oxygen than in the atmosphere. On the 20th of June the following results were obtained: in first jar, two and a half per cent., in second jar, three and a quarter per cent., and in third jar, four per cent. less oxygen than in atmospheric air. Some experiments were then made to determine the rate of access of air to the plants through the bladder, and it was found that when the jars were filled with oxygen, the average rate at which it escaped till the internal air was like that of the atmosphere, was eleven per cent. daily.

*Prof. Lindley* then read a paper by Mr. Ward on the same subject. The Professor observed, that Mr. Ward, of Wellclose Square, London, had made many experiments on the subject of keeping plants in unventilated vessels, and was the original proposer of the plan for preserving plants in this manner. The discovery of their being able to be thus preserved, was of great practical importance, as it enabled us to bring plants from foreign climates, that could in no other way be introduced into this country. The paper commenced, "Consider the lilies *how* they grow." The attention of the author was first directed to this point by accident. He had placed under an inverted jar a chrysalis, and on looking at it some time after, he found a fern and a blade or two of grass had grown under the jar, the sides of which appeared to be covered with moisture. Taking the hint, he introduced some plants of Hymenophyllum under a jar, which grew and flourished in this situation. The Messrs. Loddige then enabled him to perform some experiments on a larger scale. The plants were enclosed in glass cases, or small green-houses, made tight with paint and putty, but, of course, not hermetically sealed, and were watered once in five or six weeks. From his experiments, the author came to the following conclusions:—First, that confining the air secured a mere equable temperature for plants, as its expansion and contraction by change of external temperature, by its relation to heat in those states, prevented any great or sudden change. This was remarkably exemplified in some plants that were brought from India, which were in the course of three months successively exposed to 20°, 120°, and 40° of Fahrenheit. The enclosed plants were very frequently found surrounded by a temperature higher than the external atmosphere. Secondly, that vascular plants required to be grown in a greater quantity of air than cellular. Thirdly, that light must be freely admitted. Fourthly, that the enclosed air must be kept humid. This can be done by occasional watering, provided any means of escape for the water is allowed, but is not necessary where the water has no means of escape. Besides the advantage of enabling us to bring plants from abroad, it would also furnish to the physiological botanist the means of observing those operations of nature in his study, for which, before, he had been obliged to resort to the forest and the plain. As an instance, the author had been enabled to observe the rapid growth of a *Phallus fœtidus*, by merely devoting to it a few hours of the night. The writer concluded by suggesting that this mode of preserving tropical productions might be extended from the vegetable to the animal kingdom.

Prof. Lindley also read a letter from the Messrs. Loddige to Mr. Ward, stating that in every case in which his instructions had been attended to, foreign plants had arrived in a state of safety.

The Rev. J. Yates read a paper on the same subject. Wishing, he observed, to make an experiment, on a large scale, which might be exhibited at the meeting of the British Association in Liverpool, a green-house, nine feet by eighteen in dimensions, and with a southern aspect, had been erected in the yard of the Mechanics' Institute, in Mount-street. It was stocked with foreign plants of all kinds, to the number of about eighty species. A list of the plants, and observations on their condition and progress, accompanied the report. The general result of the experiment was, that the plants had flourished perfectly well, being in a vigorous and healthy state, without any extraordinary growth. Many of them had flowered, and Canna and some Ferns had ripened seed. The green-house had no flue, and no provision for any artificial heat. It was judged best to construct it without a flue, both as least expensive, and for the purpose of trying, by a fair experiment, to what extent plants might in this state be kept alive, even during the severity of winter, which would certainly die if fresh air were more freely admitted. It was also to be observed, that nothing had been done to prevent the water from escaping through the yellow sandstone rock, on which the green-house was erected, and hence it had been necessary to give the plants occasionally a fresh supply of water. Mr. Yates further stated, that he had also grown plants under glass in London, where no plant could be made to flourish without such a protection. Nearly a year ago he planted *Lycopodium denticulatum* in a chemical preparation glass, with a ground stopper. During that time the bottle has never been opened; yet the Lycopodium continues perfectly healthy, and has grown very much, although, for want of space, the form of the plant is distorted. Seeds which happened to be in the soil have germinated, and Marchantia has grown of itself within the glass. He also obtained a hollow glass globe of eighteen inches diameter, and with an aperture sufficient to admit the hand for planting the specimens. A variety of Ferns and Lycopodiums were then set in the soil, which was properly moistened with water. This having been done, the aperture was covered with sheet India-rubber, its attachment to the glass being made perfectly air-tight. No change of air could take place, except by percolation through the India-rubber, which was every day forced either outwards, as the air within the glass was heated and expanded, or inwards in the reverse circumstance; these Ferns grew probably as well as they would have done in a green-house or hot-house. They were all foreign, and some of them requiring a great heat. Several had ripened seed.

Mr. Gray stated, that he had grown Droseras under glass jars; one circumstance with regard to them he thought worthy of remark, their leaves did not turn red, as is usual when exposed to the atmosphere. Prof. Graham observed, that although in Mr. Ward's experiments atmospheric air had been admitted, he did not think it essential to the welfare of the plant. Plants grown in this manner only required a glass large enough to contain a sufficient quantity of air, to permit of the absorption of oxygen without deteriorating the air of the vessel to such an extent as to injure the plant. The want of red in the leaves of Drosera, he thought, depended on the presence of moisture. A singular point was, that plants growing naturally in arid soils and climates, flourished in the humid and confined atmosphere of the closed jars. He had placed under jars completely closed some plants of Cacti, which had flourished more than those not so situated. He did not think that animals could be sustained in the same manner, as they consumed all the oxygen which they inspired.—Dr. Travers remarked, that he had seen common mould, which was a species of fungus, in a tube which had been heated and hermetically sealed for two years.—Mr. Bowman had observed at the Duke of Devonshire's, Chatsworth, that Droseras did not under the jars change the color of their leaves as in open air. He wished to know of Dr. Graham, how long his Cacti had lived in a moist atmosphere; they were naturally at certain seasons of the year exposed to heavy rains. He thought it was very possible for plants and animals to live together.—Mr. Duncan inquired if plants were healthy, and fit to be transplanted to the open air when treated in this manner.—Professor Graham stated, that the Cacti had lived without access to air eighteen months. He believed that plants and animals might live together, provided the vessel in which they were inclosed was sufficiently large to enable the plants to absorb the carbonic acid gas expired by the animals. This would be a representation in miniature of what takes place in our own world.—Prof. Lindley, in reply to Mr. Bowman's question, stated, that plants suffered little when confined in carefully closed vessels. From improper treatment they may become debilitated, but he had seen them arrive from foreign countries, when treated in this manner, in the most perfect state of health. Want of skill in the management of those brought from abroad was the most frequent cause of injury. Too much water was frequently given to plants when just packed. They had better be placed in too dry, than in too moist an atmosphere. He had seen this illustrated in plants from India; plants exposed to too much moisture rotted very soon. He thought the change of color in the leaves of plants depended on their free exposure to light; the Droseras mentioned had not been exposed to the free access of light; this was certainly the case with the Droseras at Chatsworth and of Mr. Gray. The discovery of Mr. Ward was not only important in enabling us to import foreign plants, but it also rendered the ventilation of green-houses less necessary, and would enable gardeners to manage the artificial climate of their hot-houses with less difficulty. The fact that cellular plants grow best under this mode of treatment, was well established.—In answer to a question from Prof. Lindley, Mr. Gray and Mr. Yates stated, that plants had both flowered and fruited under this plan of treatment.—Prof. Graham stated that the order in which he had found plants to grow best, was, 1. Lycopodiums; 2. Grasses; and 3. Begonias.

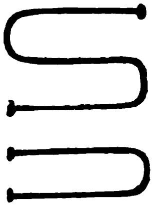
*Railway Iron.*—Mr. Mushet made some observations on Railway Iron, founded on experiments carried on for forty years. He expressed himself much surprised, that hitherto, in contracts for iron for railway purposes, fibre and hardness were not stipulated for, but were left to the chapter of accidents. Both these qualities might be attained by his method, the principal characteristic of which consisted in doing away with the refining process now in general practice, and the preventing the severe decarbonization to which the iron was at present exposed. Several specimens of iron, of extremely fine fibre and hardness, were laid before the Section, and afterwards removed to the Model Room. The great object of his process was, to obviate the evil of lamination. On some railroads they had been obliged to lay the iron two or three times; but he had little doubt, that it would soon be possible to obtain a solid rail without any exfoliation.

Mr. Cottam mentioned, that he had known a piece of iron six inches thick, and considerably bent, to be quite straightened by blows, but, at the same time, to be greatly weakened; and that he attributed this to some of its constituent crystals being driven into it, by the force of the blows, like so many wedges, thereby weakening the strength of the iron.

*Electricity.*—Prof. Henry then made a communication respecting the Lateral Discharge in common Electricity.

The primary object of these investigations was to detect, if possible, an inductive action in common electricity, analogous to that discovered in a current of galvanism. For this purpose an analysis was instituted, of the phenomena known in ordinary electricity by the name of the lateral discharge. Prof. Henry was induced to commence with this from some remarks by Dr. Roget on the subject. The method of studying the lateral spark consisted in catching it on the knob of a small Leyden phial, and presenting this to an electrometer. The result of the analyses was in accordance with an opinion of Biot, that the lateral discharge is due only to the escape of the small quantity of redundant electricity which always exists on one or the other side of a jar, and not to the whole discharge. The Professor then stated several consequences which would flow from this; namely, that we could increase or diminish the lateral action, by the several means which would affect the quantity of redundant, or as it may be called, free electricity, such as an increase of the thickness of the glass, or by substituting for the small knob of the jar a large ball. But the arrangement which produces the greatest effect, is that of a long fine copper wire insulated, parallel to the horizon, and terminated at each end by a small ball. When sparks are thrown on this from a globe of about a foot in diameter, the wire, at each discharge, becomes beautifully luminous from one end to the other, even if it be a hundred feet long; rays are given off on all sides perpendicular to the axis of the wire. In this arrangement the electricity of the globe may be considered nearly all as free electricity; and as the insulated wire contains its natural quantity, the whole spark is thrown off in the form of a lateral discharge. But to explain this phenomenon more fully, Prof. Henry remarked, that it appeared necessary to add an additional postulate to our theory of the principle of electricity,—namely, a kind of momentum, or inertia, without weight; by this he would only be understood to express the classification or generalization of a number of facts, which would otherwise be insulated. To illustrate this, he stated that the same quantity of electricity could be made to remain on the wire if gradually communicated; but when thrown on in the form of a spark, it is dissipated as before described. Other facts of the same kind were mentioned; and also, that we could take advantage of the principle to produce a greater effect in the decomposition of water by ordinary electricity. The fact of a wire becoming luminous by a spark, was noticed by the celebrated Van Marum more than fifty years ago, but he ascribed it to the immense power of the great Haarlem machine. The effect, however, can be produced, as before described, by a cylinder of Nairn's construction, of seven inches in diameter, a globe of a foot in diameter being placed in connexion with the prime conductor to increase its capacity.

Some experiments were next described, in reference to the induction of the lateral action of different discharges on each other. When the long wire is arranged in two parallel, but continuous lines, by bending the wire, the outer side of each wire *only* becomes luminous; when formed into three parallel lines by a double bend, the middle portion of the wire does not become luminous, the outer sides only of the outer lines of wire exhibit the rays. When the wire is formed into a flat spiral, the outer spiral alone exhibits the lateral discharge, but the light in this case is very brilliant; the inner spirals appear to increase the effect by induction.



Prof. Henry then stated, that a metallic conductor, intimately connected with the earth at one end, does not silently conduct the electricity, thrown in sparks, on the other end. In one experiment described, a copper wire, $\frac{1}{8}$th of an inch in diameter, was plunged at its lower end into the water of a deep well, so as to form as perfect a connexion with the earth as possible; a small ball being attached to the upper end, and sparks passed on to this from the globe before mentioned, a lateral spark could be drawn from any part of the wire, and a pistol of Volta fired, even near the surface of the water. This effect was rendered still more striking, by attaching a ball to the middle of the perpendicular part of a lightning rod, put up according to the directions given by Gay-Lussac, when sparks of about an inch and a half in length were thrown on the ball; corresponding lateral sparks could be drawn not only from the parts of the rod between the ground and the ball, but, from the part above, even to the top of the rod.

Some remarks were then made on the theory of thunder-storms, as given by the French writers, in which the cloud is considered as analogous in action to one coating of a charged glass, the earth the other coating, and the air between as the non-conducting glass. One very material circumstance has been overlooked in this theory,—namely, the great thickness of the intervening stratum, and the consequent great quantity of free or redundant electricity in the cloud. This must modify the nature of the discharge from the thunder-cloud, and lead to doubt, if it be perfectly analogous to the discharge from an ordinary Leyden jar, since the great quantity of redundant electricity must produce a comparatively greater lateral action; and hence, possibly, the ramifications of the flash, and other similar phenomena, may be but cases of the lateral discharge.

Some facts were then mentioned, on the phenomena of the spark from a long wire charged with common or atmospheric electricity. It is well known that the spark in this case is very pungent, resembling a shock from a Leyden jar. The effect does not appear to be produced, as is generally supposed, by the high intensity of the electricity at the ends of the wire by mere distribution, since this is incompatible with the shortness of the spark. In one experiment, fifteen persons joining hands received a severe shock, while standing on the grass, from a long wire, one of the number only touched the conductor; the spark in this case was not more than a quarter of an inch long.

Mr. Sturgeon was confident a well-constructed thunder rod would never be struck by lightning, as, upon the approach of an electrical cloud, it would silently discharge it into the earth.—Mr. Stevelly said, that unquestionably when the discharge was made directly upon the thunder rod, if well constructed, it would perform its office silently; but if a lateral discharge took place near it, the effect, as Prof. Henry showed, might be flashes of light and heat from the entire length of it, capable, when on a great scale, of setting fire to buildings, firing gunpowder, and other effects hitherto unexpected.—Mr. Snow Harris expressed his regret, that he had not been in the room during the early part of Prof. Henry's communication. In his opinion, the pressure of the air was an element in the phenomena not sufficiently attended to. He had produced beautiful illuminating effects by discharging electricity along a wire enclosed in an exhausted glass receiver.—Mr. Adams confirmed the statements made by Prof. Henry as to the illuminating effects of the lateral discharge; he had once seen upon the discharge of a large electrical battery, a wire splendidly illuminated by the lateral discharge, and exhibiting the coruscations spoken of by Prof. Henry.

*Aurora in Summer.*—Prof. Christie then made a communication 'on the occurrence of the Aurora Borealis in summer.'

The occurrence of an aurora borealis in England, in the middle of summer, was, he believed, a phenomenon hitherto unrecorded. He then gave an account of several very striking exhibitions of this phenomenon, which he had observed during the last summer. One, on the 19th of May, 1837, presenting two bands of arches, radiating from the magnetic west, and extending nearly to the opposite horizon, was unaccompanied by streamers. Another, on the 24th June, exhibited the usual appearance of coruscation from the northern horizon, but no arches were visible. This aurora, which was the most singular from being observed in the very middle of summer, lasted from 11h. 46m. until 12h. 20m. P. M. Other auroras were observed on the 1st, 2nd, and 7th of July, and 25th of August. On the last occasion, the author noticed a singular phenomenon, which he had, on one occasion many years previous, observed, namely, that the darkness usually attending an aurora appeared to break into the light above it. He noticed that, on the former occasion, he observed the darkness to rush through, and finally break up, two well-defined arches of white light; and recalled to the Section, that Capt. Back had described a very striking exhibition of a similar phenomenon, which he witnessed during his wintering at Fort Reliance. He particularly called attention to these and other phenomena, of the darkness exhibited in the aurora borealis, in connexion with the arches of light and the more brilliant coruscations. After recurring to other auroras which he had observed during the last summer, he inferred that it was probable that the aurora borealis was as frequently in activity in summer as during other seasons, though it might be less frequently visible. The author further stated, that during the last twelve months, no period of a month had elapsed without the exhibition, in the south of England, of one or more auroras; and pointed out the importance of inquiring into the cause of the now so frequent occurrence of a phenomenon, which some years back had been very rare. He concluded by expressing a hope, that observations of the highly interesting phenomena of the aurora would be entered upon by members of the British Association, who might have more time at their command than his own avocations allowed him for such observations.

Mr. Stevelly stated, that the dark cloudy appearance during the aurora was so characteristic, that on one or two occasions, having seen, just before sunset, these scattered black clouds, he was led to anticipate that an aurora would ensue, which accordingly manifested itself when it grew dark; and a friend, since he came to Liverpool, had boasted that he could unfailingly predict an aurora on the evening of the night on which it was to occur. He had mentioned this to Prof. Christie, who said that his own experience had been precisely similar.—Sir David Brewster said, that, by an analysis of the light of the aurora borealis, he had proved that it was direct light, and had never suffered either reflection or refraction.—Sir. W. Hamilton inquired, whether Mr. Christie had taken any notice of the very remarkable aurora which occurred on the 18th of last February.—Prof. Christie said he had observed it. The object, however, of his present communication, was to turn attention to the occurrence of the aurora in summer.—Mr. Snow Harris trusted that a wide line of distinction would be drawn between electrified luminous clouds and the true aurora. He also wished attention to be turned to the difference between magnetic needles when suspended in vacuo and in the open air. He had exhausted a very tall glass receiver, and by electrifying it, caused a very brilliant display resembling the aurora. This notably affected a needle suspended near it in the open air; but a needle suspended in vacuo was not at all effected.—Mr. Abram had no doubt whatever, but that the aurora was a magneto-electrical effect; and described an apparatus which he had contrived in order to illustrate this.

*Mean temperature at Plymouth, England.*—The mean temperature of two years, from 17,520 observations, is 52.90; that of five years, from 43,800 observations, is 52.45.

*New property of Light.*—Sir David Brewster then gave an account of a new property of light discovered by him. He observed, that his attention had lately been drawn to a very curious, and, to him, entirely inexplicable property of light. While examining the solar spectrum formed in the focus of an achromatic telescope, after the manner of Frauenhofer, he placed a thin plate of glass before his eye, in such a manner as to intercept and retard one half of the pencil, which was entering his eye, by placing it before one half of the pupil. He was then surprised to find, that when the edge of the retarding glass plate was turned towards the red end of the spectrum, intensely black lines made their appearance, as might be expected, at such regular intervals, as to represent the most exact micrometrical arrangement of wires; but upon turning the plate of glass half round, (still keeping its plane perpendicular to the axis of the eye,) so as to present the edge, past which the rays entered the eye, to the violet end of the spectrum, every one of those dark bands entirely disappeared. In the intermediate positions of that edge they appeared more or less distinct, according as the edge was more presented to the red, or to the violet end of the spectrum. A glass plate, one-thirtieth of an inch thick, gave these lines; but the thinner the glass, the more intense was the blackness, and the more distinct the lines. They were formed in any part of the spectrum; but they were best seen when the rays were intercepted which lay between the two fixed lines A and D, of Frauenhofer. An examination of these lines afforded the very best means of determining the dispersive powers of substances,. for their distance from one another increases or diminishes, exactly as the entire length of the spectrum is increased or diminished; and the number of them in the same part of two spectra is always the same.

*Comparative Composition of Cast Iron prepared with the hot and the cold blast.*—Dr. Thomson observed, that the specimens of cast iron examined, were all from iron smelted from the ironstone in the Glasgow coal-field. This iron-stone is a carbonate of iron, more or less pure. The richest is known by the name of *Mushet's black band,* which occurs in the neighborhood of Airdrie; its specific gravity is 3.0553, and it is composed of

| | |
|---|---|
| Carbonate of iron, - - - | 85.44 |
| " of lime, - - - | 5.94 |
| " of magnesia, - - | 3.71 |
| Silica, - - - - - | 1.40 |
| Alumina, - - - - - | 0.63 |
| Peroxide of iron, - - - | 0.23 |
| Coal, - - - - - | 3.03 |
| | 100.38 |

In the poorest specimens of iron-stone, the carbonate of iron, amounts to only 29 per cent., but such specimens are rejected by the iron-masters. The ore is roasted to drive off the carbonic acid ; this, at an average, reduces the weight about 31 per cent. ; it is then mixed with limestone and coal, and smelted.

When the Clyde iron-works were established, above forty years ago, ten tons of coal were requisite to produce one ton of iron. This coal was previously coked, by which rather more than half its weight was driven off under the form of gas, &c. By various improvements, the quantity of coal requisite was diminished from ten tons to seven tons thirteen cwt., and the quantity of limestone requisite for smelting one ton of iron was ten and a half cwt. When hot air (or air heated to above 607°,) was blown into the furnace instead of cold air, it was found that coal could be used without being coked, and the quantity requisite to smelt a ton of iron was reduced to two tons nineteen cwt. ; the lime was reduced to seven cwt., and the produce of iron in a given time from a furnace was more than doubled. The reason of this superiority of hot air over cold seems to be, that when the hot air enters the furnace it is immediately united to the coal, and is all consumed ; whereas, the cold air partly passes up through the materials, and produces, as it ascends, a scattered and useless combustion. Hence, when hot air is introduced, the heat at the point of combustion is greater than when cold air is used, and hence, the smaller quantity of limestone requisite, and the greater produce in iron in a given time. The specific gravity of cold blast iron is lower than that of hot blast, the average of the former being 6.7034, and that of the latter 7.0623.

The following table shows the composition of six specimens of cold blast iron from different localities :—

| | Muirkirk. | Do. | Do. | Pyrites. | Carron. | Clyde. | Mean. |
|---|---|---|---|---|---|---|---|
| Iron, . . . | 90.98 | 90.29 | 91.38 | 89.442 | 94.010 | 90.824 | 91.154 |
| Copper, . . | . . | . . | . . | 0.288 | . . | . . | . . |
| Manganese, | . . | 7.14 | 2.00 | . . | 0.626 | 2.458 | 2.037 |
| Sulphur, . | . . | . . | . . | . . | . . | 0.045 | . . |
| Carbon, . . | 7.40 | 1.706 | 4.88 | 3.600 | 3.086 | 2.458 | 3.855 |
| Silicon, . . | 0.46 | 0.830 | 1.10 | 3.220 | 1.006 | 0.450 | 1.177 |
| Aluminium, | 0.48 | 0.016 | . . | 3.776 | 1.022 | 4.602 | 1.651 |
| Calcium, . | . . | 0.018 | 0.20 | . . | . . | . . | . . |
| Magnesium, | . . | . . | . . | . . | . . | 0.340 | . . |

The constant constituents were iron, carbon, silicon, and aluminium; and manganese was a pretty frequent ingredient. The average proportions were

3½ atoms of iron and manganese,
1 do. of carbon, silicon, and aluminium.

The atomic proportions of the carbon, silicon, and aluminium, were 4, 1, 1, so that cold blast cast iron may be considered as composed of

21 atoms iron and manganese,
4 do. carbon,
1 do. silicon,
1 do. aluminium.

The following table exhibits the composition of hot blast cast iron, No. 1:—

| | Clyde. | Carron. | Carron. | Clyde. | Clyde. | Mean. |
|---|---|---|---|---|---|---|
| Iron, . . . . . . | 97.096 | 95.422 | 96.09 | 94.966 | 94.345 | 95.58 |
| Manganese, . . . | 0.332 | 0.336 | 0.41 | 0.160 | 3.120 | 0.87 |
| Carbon, . . . . | 2.460 | 2.400 | 2.48 | 1.560 | 1.416 | 2.099 |
| Silicon, . . . . | 0.280 | 1.820 | 1.49 | 1.322 | 0.520 | 1.086 |
| Aluminium, . . . | 0.385 | 0.488 | 0.26 | 1.374 | 0.599 | 0.422 |
| Magnesium, . . . | . . | . . | . . | 0.792 | . . | . . |

These constituents are in the proportion of

6½ atoms iron and manganese,
1 do. carbon, silicon, and aluminium.

| | Iron. | | Carbon, &c. |
|---|---|---|---|
| In the cold blast we have | 3½ atoms | + | 1 atom. |
| In the hot blast | 6½ atoms | + | 1 atom. |

Thus, it appears, that hot blast iron contains only about half the foreign matter that exists in cold blast iron.

Cast steel made from the best Dannemora iron, had a specific gravity of 7.8125. Its constituents were

| | |
|---|---|
| Iron, - - - - - - | 99.288 |
| Manganese, - - - - - | 0.190 |
| Carbon, - - - - - - | 0.388 |
| | 99.866 |

or it contained 55.7 atoms iron,
1 atom carbon.

In reply to questions, Dr. Thomson stated, that he had made no experiments on the comparative composition of bar iron from pigs made with the cold and hot blast, and that he had not found any phosphorus in the specimens of cast iron whose analysis he he had detailed.—Mr. Tennant stated, that the bar iron by the hot blast was equally tough, both hot and cold.—Mr. Guest inquired of Mr. Tennant, whether in the puddling, hot blast iron did not lose more than the cold blast iron: but to this no satisfactory answer was given.—Dr. Clarke contended, that as the impurities of cold blast iron are about double those of hot blast iron, it was impossible that, as suggested by Mr. Guest, this latter should undergo a greater waste in the process of refining. If such should be proved, he would consider it a chemical miracle. In continuation, Dr. Clarke observed, that manufacturers were too much in the habit of working by what he called the Rule of Thumb, and that, in particular, as the difference of the quantity of pig iron depended materially upon the heat employed, by not attending to this essential condition, iron-masters were liable to fall into erroneous conclusions as to the value of any particular improvement. Mr. Guest being called on by the President to speak to this point, stated distinctly, that he found the hot blast iron to lose more in puddling than the cold; and he had the impression that it was of inferior quality.—Dr. Thomson asked, whether the iron referred to by Mr. Guest was, or was not, made from cinder; to which Mr. Guest replied, that in some cases it was, but that his observation in reference to the greater loss experienced by hot blast iron in the refining surface was applicable to varieties in the manufacture of which cinder was not employed. —Professor Johnston expressed his surprise at the absence of phosphoric acid from the Glasgow iron, the more especially, as in the Newcastle coal-field phosphoric acid is abundant, and the nodules of clay iron-stone, which may be considered as coprolites, always, as is well known, include phosphoric acid. He also stated, that as specimens of hot and cold iron have frequently the same physical properties, it is very difficult to pronounce upon the relative value of these processes. The white and black cast iron also may have the very same composition, and therefore the quality of iron must be referred to something totally extraneous to chemical constitution. In fact, quick or slow cooling will determine the pig to be of the one or the other color.—The President observed, that, though generally speaking, black iron may be considered as yielding the best malleable iron, this could not, with any probability, be predicated of black cast iron got by the rapid cooling of the white variety, as suggested by Prof. Johnston.—Dr. Thomson stated, that cinder is a mixture of silicates of iron; and subsequently expressed his conviction, that the quality of iron, notwithstanding what had been alleged to the contrary, is chiefly dependent on its composition, and that if phosphorus, for example, or sulphur, were present, the metal could not be good. The same gentleman, in conclusion, decried the doctrine, which would place what was called the Rule of Thumb above what he considered a much more valuable guide—the Rule of Science.

*The action of Water upon Lead.*—Mr. Pearsall brought under consideration the action of water upon lead. He commenced by a reference to the researches of Col. Yorke and Prof. Christison, which demonstrate the corrosion of lead by pure water, though saline water does not dissolve it. (This fact was first noticed by *Guyton Morveau.*) The great object of his communication was to show, that rain water collected in leaden cisterns will dissolve the metal in considerable quantity, probably as hydrated oxide, but that, if such water be passed through a filter, or agitated with carbonaceous matter, it is altogether removed. This point he established in the course of some investigations having a reference to certain disastrous cases of poisoning which have occurred recently at Hull.

Mr. Mallet stated, that, according to his experience, lead alone is corroded which contains copper. This opinion was combated on the ground, that all the lead of commerce includes copper. Col. Yorke also stated, on the other hand, that he had established that perfectly pure lead is corroded by water when it contains air; that the calx is of a crystalline nature, and composed, according to his experiments, of carbonate united to oxide of lead. A gentleman, whose name we could not learn, stated, that the following experiment was instituted some years ago, and is still in progress. Into three bottles, filled, the first with Thames water, the second with distilled water containing air, and the third with distilled water deprived of air, three slips of lead were introduced, and the bottles hermetically sealed. The lead in the first has been acted upon; that in the second has been still more extensively corroded; but that in the third continues perfectly bright

The oxidation of the lead is therefore, he concluded, obviously due to the oxygen of the air.

*Fossils with Coal.*—Mr. Williamson explained drawings of sections of the Lancashire coal district. He exhibited a number of beautiful drawings of organic remains, some of which are very singular; including vegetable fossils, and teeth of sauroid fish; but the most interesting were of fossil fish, which Mr. Williamson conceived to have a close resemblance to the recent salmon. In mentioning the coal strata of Wigan, he pointed out a remarkable seam of impure cannel under the Smith's coal, which seam contains fresh-water shells. Some of his drawings represented *Goniatites* and *Pecten papyraceus.* He thought it very likely, along with some other geologists, that the different coal basins of England are parts of a great whole. He showed drawings of fish scales found in the coal strata. These have a close resemblance to the scales of recent fresh-water fish, and form an additional argument in favor of the formation of coal beds originally in fresh-water lakes or estuaries—perhaps the latter, as he found also some shells, evidently marine.

Mr. Sedgwick having stated that he would now receive the observations of any one present upon these several papers on the coal strata, Mr. Phillips came forward, and spoke of the regularity of the fibrous structure of coal as forming an important cause of its cleavage—this regularity of cleavage enabling the practical miner to work it with more facility.—Sir Philip Egerton was requested by the President to give his opinion respecting the fish, supposed by Mr. Williamson to resemble the recent salmon; Sir Philip referred to the arrangement of fish proposed by M. Agassiz, and to their geological distribution. The salmon is ranged by that eminent naturalist, under the division of Cycloidal fish, and remains of these have not been discovered in any system below that of the chalk. The fish delineated by Mr. Williamson might be referred to the genus Colopticus, and the teeth to *Diplodus gibbosus.* Dr. W. Smith remarked, that the specimens of coal exhibited by Mr. Pease would point out a mode by which coals could be touched without dirtying the fingers—what are technically called the top and bottom being the soiling sides, but the cross cleft is clean. The President said, it was a thin layer of mineral charcoal that caused the soiling.

*Changes of Level.*—Mr. Smith, of Jordan Hill, made some observations on the changes of level of land and sea, that have last taken place, instanced by the occurrence of recent marine shells and gravel at various elevations. He mentioned the shores of the Solway Frith, and of Ayrshire, the neighborhood of Paisley: also Portrush in the northern part of Ireland, and the late observations of Mr. Lyell, in Sweden. The alluvial clay of the Forth is elevated sixty feet, that of Essea one hundred and fifty feet; indeed, recent shells have been found by Mr. Gilbertson in some places at an elevation of three hundred feet. On the shores of the Clyde, over a deposit of erratic blocks, is a stratum of shells, which contains fourteen new species not now found in the river; this is a singular occurrence, as in other parts of Great Britain the erratic blocks overlie the newer Pleiocene strata, to which Mr. Smith refers this stratum.

*Silica in Plants.*—Prof. Henslow stated, that he believed the object of the author was to prove, that all plants contained more or less silica; that the silica left after burning assumed different forms, according to the species of plants, and that this process might probably be applied to the investigation of the species of fossil plants.

*Goliathus Magnus.*—A specimen of the Goliathus magnus, was also exhibited. This is the largest species of insect known, measuring three or four inches in length, and one and a half in breadth. It is also very rare, only three specimens existing at the present time in the cabinets of Europe. It was one of the rarest insects known. It had been offered for sale at the price of fifty guineas, and he had himself offered twenty guineas for a specimen. It belonged to the extensive family of the Cetonidæ. This family was one of the most extensive and best known groups of insects that we possessed, and afforded the best opportunities for acquiring ideas of general arrangement. It contained six hundred species, only six of which were British. The family *Buprestidæ*, perbaps equalled them in numbers.

*Wood in the Sea.*—The President then exhibited some wood from the new pier at Southampton, that had been attacked by the *Limnoria terebrans*. He had been applied to, by Capt. Du Cane, mayor of Southampton, for his opinion as to what was the best course to be pursued, as the existence of the pier was threatened by these devastating animals. He had recommended, that stone be substituted in the pier for wood. He believed that this was the only plan, for wherever wood was exposed to the *gentle action* of salt water, these crustaceous animals attacked it. They never attacked wood exposed to the more violent action of the waves of the sea.

The Rev. F. W. Hope stated, that a memoir had been published on this subject, in the last volume of the Transactions of the Entomological Society. He had recommended gas tar to be applied over the wood, but as this would require renewing, it would in the end be as expensive as covering the wood with iron, he should therefore prefer the latter plan. He had heard, that Kyanized wood was not attacked by white ants, and he thought it might be applied to prevent the attacks of these terebrating animals. These remarks led to a general conversation on the subject of preserving wood from the attacks of insects and crustacea, as well as the bottoms of vessels from the adhesion of plants. The President observed, that he had seen vessels with tons of algæ, polypiferæ, and other plants and animals, attached to their bottoms. Experiments were related, and observations made by Messrs. Francis, Hope, and Gray, and Prof. Henslow; and Mr. Francis was requested by the President to draw up a paper on this important subject, to present to the Association at their next annual meeting. Mr. Francis stated, that sap-wood, exposed to the action of chloride of mercury, became as durable and fit for use as the heart-wood.

*Respiration.*—Dr. Holland replied, that he had made repeated experiments, and had invariably found that a series of deep inspirations did always bring to the lungs a larger quantity of blood than previously existed. The pulse, which before had only been seventy or seventy-five, became eighty-five, and in some cases ninety, and was proportionably debilitated. Setting aside all theory, two effects followed—change in the rapidity of the pulse, and in its force. He brought forward a theory to account for these effects. But, letting his own theory alone, it was quite clear that inspiration must have an effect on the circulation. Dr. Carson had also stated that air passed directly into the blood. He had never heard this opinion before. All they were acquainted with was, that air was so inspired that a certain change was effected by it in the blood. By chemical investigation they found that the carbonic acid gas, which was exhaled, existed as carbon profusely in the blood, and united with the oxygen inspired; hence they had carbonic acid. Dr. Carson had stated still further, that sighing improved the circulation. He had paid considerable attention to this, and he could not say that it improved it except in one way, and that was, it occasionally gave freer play to the lungs. They saw persons after being interested in any story almost suspend their breath, or, in other words, forget to breathe; and as soon as the interest of the story terminated there was a very deep inspiration, which relieved the blood in the chest. But he was satisfied, that a series of inspirations did not invigorate the system. Dr. Carson had also stated that the blood was not facilitated in its return by inspiration. Experiments had frequently been performed which proved this.

*Dust in the Lungs.*—Dr. Macintosh read a communication from a medical student, on a disease of the lungs caused by the deposition of particles of dust. It would contribute, he observed, towards the elucidation of that class of diseases affecting artisans, which had, in a more systematic form, been treated by Mr. Thackrah. In the neighborhood of Edinburgh were many stone-quarries, and the workers in which not unfrequently died from consumption. A mason, a worker in the Craigleith-quarry, was ill; he was bled and treated for a common cold, recovered, and returned to his work. A short time afterwards he was again taken ill, and, two years after the first attack, he died. During his illness percussion afforded a dull sound; on the right side the stethoscope indicated no respiratory murmur; on the left a puerile râle. After death, the lungs presented a black appearance; 20 oz. of fluid were found in the right side, and 4 oz. in the left; there was no membrane, the pleura being fibrous, which was rare. Dr. Alison stated he had only seen this state once, being on the pleura and cardiac portion of this kind of membrane; both lungs were completely studded with black tubercles, as if they were melanotic, and cut like cartilage. Similar projections were on the pleura, and the bronchial glands were long and hard, grating when cut with the scalpel, owing to a cretaceous secretion like bone. The analysis of this cretaceous matter showed it to be principally the carbonate of lime. In the bronchial glands were carbonate of lime, silica, and alumina. He directed particular attention to this analysis, for Dr. William Gregory has published an account of the Craigleith-quarry stone, and the analysis of this stone gave the same ingredients as those found in the lungs of the workman. Dr. Gregory found in the stone carbonate of lime, silica, and alumina. The deduction must necessarily be, that this (pointing to a preparation of the lungs which he exhibited) must be an absolute deposition of the Craigleith-quarry stone, from small particles taken into the lungs during respiration, producing consumption and death. Dr. Macartney had seen many black glands at the root of the lungs, and dispersed through its substance, but they were not hard. It was stated that fibrous concretions in the chest were rare; this did not accord with his observations. In his museum, at Trinity College, he had placed many examples of this disease. The inflammation gave, first, condensed lymph, changed it into fibrinous, converted it into cartilage, and finally into bone. Dr. Macintosh replied in the negative, to the question if any other part of the body contained stone.

*Variations of Pressure on the Human Body.*—Sir James Murray presented to the Section an apparatus for the purpose of withdrawing atmospheric pressure from the surface of the body, partially or wholly. He presented his reasons and observations to the Dublin Medical Section of the British Association, but they were not well understood, for want of apparatus and drawings. These he had now got, which, besides much labor and time, had cost upwards of 100*l.*; and he trusted, since he was becoming old, some of the Members would perfect them. The first machine was for the whole body, and resembled in form a slipper-bath, with the addition of a separate part to cover the upper portion of the body, the head only being free. The upper portion was luted to the lower, by means of a composition (used in making printers' rollers for inking the types,) and fixed in a groove; and, if necessary, the patient's face and head could be contained in a glass case, luted to the machine in the same manner, and respiration carried on by a tube. The air from the machine was removed by means of an exhausting syringe, screwed on towards the bottom part of this apparatus. He had tried this machine in the collapsed cases of cholera, and exhausted the air from the body, taking off one ton of atmospheric pressure. The consequence was, that the vessels became full and turgid, and the body, previously shrunk, was rounded and red. He had tried it repeatedly, and the same results followed. The process might be reversed, and pressure of air made on the body, even to the amount of

100 tons, without damage; but beyond this it would not be safe. He had tried it repeatedly in asthma. The principle was applicable topically, and parts of the body could be submitted to the action of the machine, modified so as to be suitable to them. He exhibited a contrivance, of a long tin tube, made air-tight, and with a piece of wet bladder round one end, which was open; at the other end, which was closed up, a small exhausting air-pump was placed. A patient, with a paralytic wrist, put his arm into this; the wet bladder was tied round his arm at the top, to make it air-tight, and the atmosphere was then pumped out of the tube. The atmospheric pressure being taken off, the limb became turgid, the circulation was increased, and the part affected was soon cured. There was another adaptation of the same contrivance to the limbs, to draw off the effect of congestion of the brain; and one to stop hæmorrhage in an injured hand, limb, or other extremity. An exhausting pump was fixed to the end of a bladder, the limb was put into the bladder, and the neck then tied round to make it air-tight. The air was then completely exhausted by means of the pump, which compressed the bladder so close to the skin as effectually to stop even the pores of the skin. The same contrivance of a bladder and exhausting pump was also applied for the cure of ulcerated legs, by preventing evaporation of the ulcers, by exhausting the air, and making the collapsed bladder adhere tightly all round. For irregular surfaces he thought the instruments of particular value, since no dry-cupping could be used there. If this plan had been known when those melancholy deaths from dissection cuts took place in Dublin, and dry-cupping could not be had recourse to, it would have been fortunate. The machine would be particularly advantageous in withdrawing blood from particular parts to others more remote. Thus, in cases of congestion of blood in the head, where bleeding had been carried to such an extent that it would not be safe to carry it further, owing to the great general loss in the circulation, blood might be made to accumulate in other parts, as in the legs. The case of a well-known brewer in Dublin was treated on this principle, and recovered. Sir James then enumerated the kinds of cases where the apparatus might be used,—asthma, defective external circulation, aneurism, tumors, paralysis, &c.

*Structure of the Brain.*—Mr. Carlile further adverted to the particulars of several dissections of the brain in his possession, but which were too much in detail for perusal before the Section. The conclusion to be drawn from these dissections is, that in the brain of idiots the internal structure is always defective, and, in many instances, more so than the size or external form; and that in the brains of persons not idiotic, but possessing various degrees of intellectual power, very marked differences in internal structure may be observed by those who dissect the brain in the manner first proposed by Dr. Macartney, in a paper read by him before the British Association, and published in their Transactions for 1833. It is a most reasonable supposition, from the facts just mentioned, and from observation of the structure of the brain in animals, that the intellectual and moral character is much influenced by peculiarities in the organization of the various plexuses or ganglia, of which the brain essentially consists. Phrenologists have wholly neglected the internal structure of the brain, and have confined their attention to the size of certain portions at the surface; a method which is calculated to mislead,—amongst other reasons, because the surface of the brain is not the only part essential to the exercise of the intellectual and moral qualities, and size is a very inadequate measure of power, unless the structure of the part be also taken into consideration. As an example of an erroneous method of investigation, Mr. Carlile quoted an elaborate paper, by the celebrated Tiedemann, in the Philosophical Transactions, in which he concludes, from measurements of the size of the cranial cavity in Negroes and in Europeans, that the faculties of both are alike; whereas, it is well known to those who have opportunities of observing the children of Negroes and of Europeans educated together at the same school, that, as long as the perceptive faculties chiefly are employed, equal progress is made by both classes of children; but that as soon as the reflecting and comparing powers are required, as in the learning of mathematical or other inductive sciences, the inferiority of the Negro is almost uniformly made manifest. Mr. Carlile concluded, by inviting the attention of physiologists to the examination of the minute structure of the brain, and stated his conviction, that by a comparison of its peculiarities with the differences of mental capacity observed during life, much light would be thrown on the functions of different parts of this organ.

*The Plague.*—Mr. Urquhart read a paper, 'On the Localities of the Plague in Constantinople.' He stated, as the result of three years' observation, that this disease, if it did not originate in localities close to cemeteries, was greatly aggravated by the proximity of burial-grounds, especially when the towns and villages stood on a lower level than the neighboring cemeteries. It was known, that the Turks, from religious prejudices, made their graves hollow, and placed a very shallow covering of earth over the dead. The mephitic vapors arising from the putrescent bodies, tainted and polluted the surrounding atmosphere: and that this disease was connected with atmospheric influences, was a fact known to the Turks themselves; among whom it was commonly said, that birds abandoned the localities where plague prevailed, and fruits became more abundant. Mr. Urquhart declared, that these observations were confirmed by his own experience: he regretted that he had no statistical data to offer to the Section, and hoped that, attention being now directed to the subject, it would lead to the prosecution of a more regular inquiry.

Mr. Wyse said, that his personal experience in Syria, Turkey, and Egypt, enabled him to corroborate Mr. Urquhart's statements: he had never passed the large cemetery, near the gate of Adrianople, without a distinct perception of noisome effluvia, which in humid weather were peculiarly offensive. He trusted that the attention of government would be directed to the subject, and a series of questions addressed to the consular agents in the Levant. —Dr. Bryce said, that he had long directed his attention to the subject of plague, and made numerous observations during his residence at Constantinople; but scarcely had he formed an hypothesis, when it was contradicted by some new facts. Mr. Urquhart's remarks had first given him a ray of light to guide investigation, and from many circumstances which now occurred to his mind, he was led to place considerable reliance on Mr. Urquhart's account.—Col. Briggs stated, that the plague was unknown in India, which he attributed to the custom of burning the dead. It was anciently unknown in Egypt, where the dead were embalmed; among the Parsis, who expose their dead in a walled cemetery, to be devoured by the birds of the air, plague rarely or never occurs. In the countries which now constituted Turkey, pestilential diseases were very rare in the classical ages.

*Statistics of Crime in Liverpool.*—"The report gave, as the result of rigid inquiry, a criminal population to this town of 4,200 females, and 4,520 males, 2,270 of the latter being professional thieves, and the remainder occasional thieves, living by a combination of labor and plunder; and the whole was set down at upwards of 700,000*l.* This does, at first sight, appear incredible; but an investigation, pursued with much labor, and not unattended with obloquy, convinced me the statement contained no exaggeration.

"A more recent inquiry, carried on by better means, afforded by a more experienced police force, not only confirms these details, but leaves an impression that the number of criminals was underrated. In an inquiry of this kind, an approximation to accuracy is all that can be expected; and all I purpose to do is to furnish the society with the most accurate data which are accessible.

"I hold in my hand two or three returns, about the correctness of which there can be no doubt. They contain the number of persons brought before the magistrates, and the number committed; the number of felons apprehended, and the number committed; they also give the age of the juvenile felons. In the year 1835, there were taken into custody 13,506 persons, of whom 2,138 were committed. In 1836, there were taken into custody 16,830, of whom 3,343 were committed. Up to the 13th of the present month, the number taken into custody in eight months, was 12,709, of whom 2,849 were committed. From July, 1835 to July, 1836, the number of juvenile thieves, under eighteen years of age, apprehended was 924, of whom 378 were committed. From July, 1836, up to the present day, the number of juvenile thieves taken into custody was 2,339, of whom 1,096 were committed. There were in custody, during the same period, upwards of 1,500 well-known adult thieves.

"In our report, juvenile thieves were set down at 1,270: it now seems that the number was very greatly underrated, for the most expert officer does not pretend to say that one-half were taken into custody.

"In the returns made by the old watchmen, the number of houses of ill-fame was set down at 300; but this return referred only to the *notorious* ones. A full and complete return has since been made, and the real number is 655, exclusive of private houses in which girls of the town reside. In all the houses of ill-fame, females reside; and, allowing an average of four to each house, the number residing in such places only would be 2,620.

"This return is further confirmed by the fact, that in the year preceding the inquiry, there were apprehended 1,000 females of a particular description.

"Another return has been placed before me, which, though not absolutely bearing on the subject, is not without interest. Of 419 individuals now in the gaol, 216 profess the religious creed of Church Protestants, 174 Roman Catholics, 8 are Methodists, 17 are Presbyterians, 2 are Unitarians, 1 Baptist, and 1 Independent. 141 can neither read nor write, 59 read imperfectly, 38 read well, 127 read and write imperfectly, and 56 read and write well." Amount of property stolen, about one million sterling annually.

*Keels of Ships.*—Mr. Lang addressed the Section on his improvements in Ship-building. He fills up the floor perfectly solid, puts in a kelson and a keel in the usual way, bolting them well together, and caulking all up. On each side of this keel he fixes another broad and flat one, and over these another, all secured in a peculiar way, by dovetailing, but so as one may come off without bringing off the other, and the whole without damaging the floor; over all he puts a false keel. The depth from the inside of the floor to the bottom of the false keel is about twice the depth of the kelson, and the breadth of the three keels under the floor a little more than the depth from the top of the kelson to the bottom of the false keel. He caulks with Borrodaile's felt, observing that, when the seam is caulked in the usual way, outside and inside, the oakum does not reach the centre, but leaves a hollow, where damp lodges, to the destruction of the timbers. This plan has, it appeared, been adopted by the English and by foreign governments. It was, Mr. Lang admitted, rather more expensive than that usually adopted in building merchant-ships.

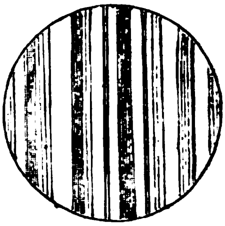
*Safety of Steam Vessels.*—Mr. Williams then offered some observations, as a practical man merely, on a method for preventing accidents from the collision of steam vessels, which was in practice in the vessels belonging to the city of Dublin Steam Packet Company. The danger at present arose from this,—that a local injury, as in the late instance of the *Apollo*, admitted the water through the whole body of the vessel. The improvement would confine the water to the section in which the injury took place. It consisted in dividing the vessel into five water-tight compartments, by iron divisions or bulk-heads, the only objection with respect to which arose from the difficulty of fixing them in a timber frame. This was obviated by making the side of the vessel solid for twelve inches before and aft the bulk-head, and closing up the interstices with felt. As to the number of these compartments, he had found, after several trials, four bulk-heads, forming five sections, unexceptionable. The length of these sections was arbitrary; Mr. Williams made the centre one enclose the machinery, and those at the stem and stern of comparatively small length. He had, two days before, tried several experiments with the *Royal Adelaide*, having admitted the water by boring holes, first into the foremost section, next into the second, and afterwards into the third; and in each instance very little depression had been produced in the stem, never exceding twelve inches, while there was no disturbance to the men at work. In cases of fire, too, there was a double advantage from this arrangement; the fire could not extend far under deck, so that the men could work easily in extinguishing it,—there would be no current of air throughout, and the water might, if necessary, be admitted to the section attacked by the fire, without any general inconvenience, and without any danger. Mr. Williams intimated, in conclusion, that a vessel would be placed by the Company at the disposal of members of the Association returning to Ireland, as it had been to transport them to Liverpool.—The President then closed the meetings of the Section, by a few remarks on the successive development of power apparent in it. Though originally only an offset from another Section, it now rivalled, if it did not exceed any of the others, in the variety and interest of the topics discussed, the attendance of members, and the ability of the papers laid before it. He, as its original proposer, felt especially interested in its progress, and hoped to see it still more distinguished.

*Heat of the Earth.*—The sun's heat was found to extend to variable depths at various places, and with many alternations of increase and diminution; and it was in general necessary to descend from one to two hundred feet before the effect of this cause disappeared; from thence downwards, the evidence of an increasing temperature seemed to be quite satisfactory. At a colliery at Wigan, where the surface mean temperature was 50°, at 50 yards deep the temperature was constantly 53°; at 150 yards deep the temperature was 56.75°; at 250 yards 63°. From this set of observations, it appeared that a descent of 100 yards was accompanied by an increase of temperature of about 6.25°, or about one degree for sixteen yards; the result of the observations made in France giving one degree for about each fifteen yards of descent.

*Magnetism.*—Mr. Fox drew attention to the advantages conferred on this branch of science by Lieut. Burns. He exhibited charts drawn by him, in which the dip and variation were laid down, with extreme accuracy, in several parts of the world. He gave a curious instance of the value of a knowledge on these subjects; as the ship drew near a promontory of the Cape de Verd Islands, the action of the rocks became perceptible to this accurate observer, who was thereby warned of the neighborhood of land. He also was frequently able to guess at the nature of the rocks at the bottom of the sea from similar indications.—Major Sabine explained, that the Report now laid before the Section, related exclusively to observations made in Great Britain; hence he had not alluded to any of these subjects, nor to other general results which many members had urged him to bring forward.—Prof. Phillips said, that the dip changed frequently in the course of a day; in some observations which he had made at several stations between Ryde and York, he had found the dip to vary so much as six or seven minutes in the course of the day.

*Diamond.*—Sir D. Brewster now read a notice of a new structure in the diamond.

Sir David said, that having communicated to the Geological Society an account of certain peculiarities in the structure of the diamond, which confirm the theory of its vegetable origin, he was desirous of submitting to the consideration of this Section a new structure which he had recently detected in that gem, and which indirectly supported the same views. In consequence of the diamond having been used as the fittest substance for forming single microscopes of high power and small spherical aberration, the attention of opticians has been drawn to the imperfections of its structure. Mr. Pritchard, who first succeeded in executing lenses of diamond, put into the hands of Sir David for examination, a plano-convex lens about the 30th of an inch in diameter, which he had found unfit for the purposes of a microscope in consequence of its giving double images of minute objects. As Sir David had previously shown, that almost all diamonds possessed an imperfect doubly refracting structure, as if they had been aggregated by irregular forces, compressed or kneaded together like a piece of soft gum or an indurated jelly, he had no doubt that the double images were owing to this structure, as there appeared, on an ordinary examination of the lens, to be no other cause to which it could be reasonably ascribed. This was also Mr. Pritchard's opinion, and the existence of such images prevented opticians from rashly cutting up diamonds which might turn out useless for optical purposes. As lenses of sapphire and ruby, which Sir David had long had occasion to use in very delicate microscopical observations, produced no duplication of the image, although the rays passed in directions in which the double refraction was much greater than in any specimen of diamond which he had examined, it occurred to him that the double images might arise from some other cause. He therefore proceeded to examine the light transmitted through the diamond, by combining it with a concave lens of the same focal length, in order to make the rays pass in parallel directions through its substance. This experiment indicated no peculiarity of structure at all capable of producing a separation of the images, and he was therefore led to examine the plane surface of the lens by reflecting from it a narrow line of light admitted into a dark room, and examining the surface with a half-inch lens. While turning round the plane surface of the diamond, he was surprised to observe the whole of its surface covered with parallel lines or veins, some of which reflected the light more powerfully than others, so as to have the appearance of a striped ribband, somewhat resembling the rude sketch here given, which shows that the plane surface of the diamond, in a space of less than *one-thirtieth* of an inch, contains many hundred veins or strata of different reflective and refractive powers, as if they had been subjected to variable pressures, or deposited under the influence of forces of aggregation of variable intensity. If, Sir David observed, the planes of these different strata had been perpendicular to the axis of the diamond lens, their difference of refractive power would produce no sensible effect injurious to the perfection of the image; but if these strata are parallel to that axis, as they are in the lens under consideration, each stratum must have a different focus, and consequently produce a series of partially overlapping images.



The results of this experiment in restoring the diamond to its value as an optical material, in so far as it enables us to cut it in a proper direction, and select proper specimens, and its connection with some delicate researches of Profs. Airy and Maccullagh, on the superficial action of diamond upon polarized light, possess considerable interest, but the fact of a mineral body consisting of layers of different refractive powers, and consequently different degrees of hardness and specific gravity, is remarkable. There were several minerals, such as *Apophyllite*, *Chabasie*, and others, in which Sir David said that he had found different degrees of extraordinary refraction in different parts of the crystal; but this variation of property depends upon a secondary law of structure; and he believed that there was no crystal, either natural or artificial, in which the properties of ordinary refraction, hardness, and specific gravity, varied throughout its mass. This peculiarity of structure, therefore, might be regarded as an indication of a *peculiarity of origin; and as there are various strong arguments in* favor of *the opinion, that the diamond is a vegetable* substance, the new structure which he had described might be considered as an additional argument in favor of that opinion. He had, in a former paper, placed it beyond a doubt, that the diamond must have been in a soft state, like amber or gum, and capable of having its structure modified by the expansive force of air or gaseous bodies imprisoned in its cavities; and therefore the fact of its being sometimes composed of strata of different degrees of induration and refractive power, was more likely to have been produced by pressures varying during the formation of the crystal, than by any change in the intensity of the forces of aggregation of its molecules. Such a change might have been supposed probable, had it been found in another crystal.

*Prof. Bache on Heat.*—The object of this communication is to call the attention of the Section to the researches of Prof. Bache of Pennsylvania, which seem not to have been so fully appreciated in this country as they deserve. That gentleman, at the outset of his inquiries, refers to a paper of Prof. Powell, in which the difficulties unavoidably attending any comparison of radiating effects of surfaces are pointed out from the impossibility of determining precisely in how many other respects besides those of color and polish of surface, the coatings applied may not differ. In contending for the necessity of equalizing the coatings compared, in other respects, before we can estimate the effects really due to the state of the surface, he must, of course, be understood to speak under the qualification acutely referred to by Prof. Bache, dependent on the fact noticed by Leslie, that radiation takes place not only from the surface, but from a certain minute, though sensible depth, which differs in different substances.

Taking this into account, the general meaning, as well as importance of the caution, will be manifest. In the sequel, Mr. Bache gives some very precise experimental proofs of the truth of the law just noticed, and shows, by successively adding fresh coats of the pigment, the precise limit beyond which such addition ceases to increase the radiating power,—which, in fact, there comes to a maximum, and with greater thicknesses decreases.

When this point had been ascertained carefully for each pigment, their effects were observed with great accuracy, and compared with a standard surface under similar circumstances; the observations include a considerable range of substances, differing both in color and other properties. The results exhibit no correspondence of the greatness of effect with the color. The source of heat was hot water:—the author allows fully the distinction between properties of heat of this kind, and that connected with light; in the latter case it is evident that color is an essential element; a wide field is yet open for tracing on what the effect does depend: and again, since Melloni has pointed out the existence of many kinds of heat, differing in their relations to screens, to trace also their different relations to surfaces.

*Uric Acid and Urea, by Prof. Liebig.*—The important part which uric acid performs in the animal economy, has for a long time attracted the attention of the most distinguished physicians and chemists. Uric acid forms in one class of animals the whole of the excrement, and in another class it is its principal constituent, and it is accompanied by urea, a never-failing constituent of the human urine. Its extraordinary production in that morbid state of the body, which we call a predisposition to gout, is well known to give origin to one of the most painful diseases to which mankind is liable. It may be affirmed with the utmost certainty, that urea and uric acid are products of the organization. We cannot discover their existence in any part of our food, nor do they constitute a part of any organ, as fibrine does of the blood; but they are chemical combinations of a peculiar nature, on which account they come more within the range of chemical investigation than any other bodies of animal origin. Prout's masterly analysis has long since removed every doubt respecting the composition of urea, and the extraordinary, and, to some extent, inexplicable, production of this substance without the assistance of the vital functions, for which we are indebted to Wöhler, must be considered one of the discoveries with which a new era in science has commenced. Wöhler observed, that when cyanic acid is made to combine with ammonia, the product is urea; and he and I have, in a set of experiments which we made together, proved that these two bodies, when first combined, form cyanate of ammonia, a salt analogous to every other ammoniac salt; that is to say, the base can be replaced by other bases, and the acid by other acids: but that, a few minutes after the combination has taken place, all these properties disappear. We can no longer detect either ammonia or cyanic acid. A new substance has been formed, *entirely different* from every other chemical compound. To follow out the characters of urea, would here be quite out of place: it was, however, necessary to allude to it from its intimate relation to nitric acid.

The elementary composition of uric acid has also been established beyond a doubt. We are certain that it may be expressed by the formula $C_{10} N_4 H_4 O_6$. We know also that this acid combines with the different bases, and forms salts. Inorganic Chemistry is satisfied with the determination of these properties, but it must be evident that this formula can give us no idea of the manner in which the elements are united together to form this substance. If we admit the principle, that no ternary or quaternary compound can be formed, except by the union of a binary compound with an element, or of two binary compounds with one another, it is clear that any further investigation of uric acid must be carried on with the intention of discovering the compound elements into which it may be resolved.

This investigation, which promised to yield the most important results, both for Medicine and Chemistry, Prof. Wöhler and I determined to undertake together. In Medicine, it was evident that we might have some new method of destroying calculi in the human bladder, without the application of external force. In Chemistry, the most interesting discoveries were also to be expected, as we had not the slightest doubt that urea, xanthic oxide, cystic oxide, oxalic acid, (which last substance is well known to constitute frequently an ingredient in unary calculi,)—that all these bodies are produced by the decomposition of one single substance, and that substance uric acid.

Our analytical investigations of these various bodies have not yet made sufficient progress to enable me to communicate them here. My intention at present is, to point out the plan which we followed in our attempts to decompose uric acid into its proximate elements, and the singular results which we obtained. But, before proceeding to do so, I should like to notice a very remarkable compound, which will, I think, serve greatly to illustrate the subject we are at present occupied with.

Winkler found, that when the distilled water of bitter almonds was mixed with muriatic acid, a new acid is obtained. The distilled water of bitter almonds, in a pure state, contains nothing but prussic acid and oil of bitter almonds, (hydret of benzoyl.) When treated with muriatic acid, we obtain sal ammoniac and the new acid, and nothing else. It is evident from this, and the conclusion is corroborated by the ultimate analysis of the new acid, that the hydro-cyanic acid of the liquid is decomposed by the action of the muriatic acid into ammonia and formic acid; that the ammonia combines with the muriatic acid, and that the formic acid, in the nascent state, unites with the oil of bitter almonds, to form a compound acid, in which the power of saturation of the formic acid is not changed. This acid performs, in every respect, the part of a simple acid; and its existence has rendered probable the supposition, that the same views respecting other acids are not without foundation. Another interesting fact respecting this acid is, that when heated with hyperoxides, it is decomposed in a particular manner, only one of its proximate constituents being oxidized, while the other suffers no change. The products obtained are carbonic acid and oil of bitter almonds.

Now, I think it must be evident to every one, that uric acid must possess a composition similar to that of the acid just mentioned; and, therefore, that its oxidation in the same manner would, in all probability, lead to interesting results. We obtained, in fact, results which corresponded to our expectations. Uric acid may be considered as a compound of urea, with a peculiar acid—that is, we may view it as analogous to nitrate of urea.

This acid contains the radical of oxalic acid, combined with cyanogen. I have attempted to show, in some former researches, that carbonic oxide, and not carbon, constitutes the radical of carbonic acid, and of oxalic acid, and that phosgene gas might be considered as containing the same radical in combination with chlorine. If we indicate carbonic oxide by R, these compounds will be as follows:—

1. Phosgene gas $R+Cl$. 2. Carbonic acid $R+O$. 3. Oxalic acid $2\,R+O$.

Now, the acid which combines with urea to form uric acid, may be expressed by the formula $R+Cy$. Viewed in this manner, the composition of uric acid will be $4\,(R+Cy)+Ur$.

Uric acid, when heated with brown hyperoxide of lead, was decomposed into three different products, oxalic acid, urea, and a peculiar substance, which we may view as a compound of cyanogen and water, and which is identical with a body long known, *called allantoic* acid, from having been first found in the allantoic fluid, *but* which it would be better to call allantoin, as it is capable of acting equally as an acid and a base.

One atom of uric acid, decomposed by the action of two atoms of hyperoxide of lead, is converted (supposing three atoms of water to be present) into two atoms of oxalate of lead, one atom of allantoin, and one atom of urea.

1 atom uric acid + 2 atoms hyperoxide of lead

$$(C_{10}\,N_4\,H_4\,O_6)+Pb_2.\,O_4$$

gives

$(R_4+O_2)$ oxalic acid $(+2\ Pb.\ O)$ oxalate of lead 2 atoms

$(4\ Cy+3\ Aq.)$ allainton

1 atom urea.

Allantoin is the second body belonging to the animal organization, which we can form artificially in the laboratory. This substance can also be directly produced by the decomposition of cyanogen and water. It yields, when decomposed by other bodies, all the products which, from its formula, might be expected. Thus, with alkalies, it yields oxalic acid and ammonia, with strong sulphuric acid, carbonic acid, and carbonic oxide.

There are many bodies similar to urea and allantoin, all of which will probably, at a future period, be produced by artificial means; but, in order to arrive at this, the final object of investigations in organic chemistry, a great deal of labor, and that labor of a combined nature, will be required. I am certain that this object will be obtained. Organic chemistry has made its first step, and already its field has been extended to a very surprising degree. We meet every day with new and unexpected discoveries. It is, however, remarkable, that in the country in which I now am, whose hospitality I shall never cease to remember, organic chemistry is only commencing to take root. We live in a time when the slightest exertion leads to valuable results; and, if we consider the immense influence which organic chemistry exercises over medicine, manufactures, and over common life, we must be sensible that there is at present no problem more important to mankind than the prosecution of the objects which organic chemistry contemplates. I trust that English men of science will participate in the general movement, and unite their efforts to those of the chemists of the continent, to further the advance of a science which, when taken in connection with the researches in Physiology, both animal and vegetable, which have been so successfully prosecuted in this country, may be expected to afford us the most important and novel conclusions respecting the functions of organization.

*Non-decomposition of Carbonic Acid by Plants.*—Dr. Dalton communicated through a friend, a short paper 'On the Non-decomposition of Carbonic Acid by Plants.' He calculates, that in 5000 years, animals supposed to live upon the earth, would produce but .001 of carbonic acid, so that the assistance of plants to purify our atmosphere is not necessary. By experiment, he found, that a hot-house does not contain more or less carbonic acid, by night or by day, than the external air, and the results were the same in a number of repetitions of the experiments. This paper was said to have been penned during the convalescence of its illustrious author from a late attack of illness, and was listened to with the greatest attention.

*Galvanic Formation of Metallic Copper.*—The present is the first occasion on which native copper has been found, actually detected, as it were, in the very act of formation in the mine shaft. The Cronebane mine has been wrought for a very lengthened period, and has an additional interest as connected with the present subject, from the electro-magnetic condition of the next mine to it, the Connoree, which is part of the same vein, having been determined by Mr. Petherick, (*Philosoph. Mag. 3d Series*, vol. 3.) He found it deflected the galvanometer needle 18°—that the ore was negative, and the ground positive. The lode is situated in clay slate, dipping to the S. W. The mine water is strongly cupreous, and deposits a slimy sediment of iron, and organic matter, probably "Glairine." In this slime, and adhering to the timbering of the mine, the crystals of pure malleable copper were found in considerable quantity. The mine water from whence these masses were formed, has a specific gravity of 1.032, at 58° Fahr. When evaporated to dryness, it leaves a horny residue, smelling of animal matter. It contains the mixed sulphates of copper and iron.

Amongst the many forces in operation to produce this metallic aggregation, the author suggests the possibility of galvanic action, between the lode and the timbering of the mine; having found the galvanometer much affected by a small series of plates of grey copper ore, and of fir timber, saturated with solution of sulphate of copper under the air pump—the exciting fluid being the water of this mine.

*Browning of Gun Barrels.*—Mr. Ettrick submitted to the Section a paper on browning gun barrels. After various experiments, Mr. Ettrick discovered that the process consisted wholly in procuring a *permanent* peroxide of iron, and then coloring such oxide. He had procured not only all shades of brown, but a perfect black, by mixing 1 part of nitric acid with 100 parts of water, and applying this to the barrel with a rag moistened with it. It is material that the rag should be only so much wetted as to damp the iron, for if the fluid be allowed to stream, the oxidation will be unequally performed. It is also material that the barrel should be well smoothed and polished, and all greasiness removed by chalk before the browning commences, otherwise a bright brown is not attainable. The barrel, after being wet, should be placed for an hour or more in a window on which the sun shines, and when this process has been thrice repeated, the superfluous rust must be removed by a scratch brush consisting of a quantity of fine iron wire tied up into a bundle. This process being repeated eight or ten times, the barrel will have acquired as good a brown as it frequently receives from the common gunsmiths; but to do away with the disagreeable rusty appearance, it is necessary to proceed to color the oxide, which Mr. Ettrick accomplishes by dissolving 1 grain of nitrate of silver in 500 of water, and applying this solution like the browning liquid. The number of repetitions of the nitrate of silver water would depend on the shade of brown required, but Mr. Ettrick found from 1 to 5 or 6 amply sufficient. The barrel is to be placed in the sunshine to obtain a dark color. The last process was to apply the scratch brush freely, though lightly, and then polish the whole by bees' wax. Mr. Ettrick had, since the date of his own invention, discovered the process used by workmen generally, and long kept secret, but by the plan described a much finer brown is attainable than that gained by the trade.

*Fossil Fishes—Agassiz's great work going on.*—Mr. Dawson exhibited a collection of fossils from New South Wales.—Mr. Murchison communicated some information which he had lately received from M. Agassiz, who was bringing out some new livraisons of his great work on fossil fishes, and he mentioned that in order to enable that gentleman to carry on his work, a further grant of money would be recommended by the Geological Committee. The remains of fish had been found to be the most valuable of all indexes for determining the ages of rocks, as there was a plain separation of these animals in formations of different ages. Mr. Murchison showed drawings of some of these fossils, and remarked that in the lias and the older beds the fishes were characterized by a tail quite different from that belonging to those found in the newer formations, and he exhibited on a board representations of some of the peculiarities of those discovered in the Silurian rocks. He must record the names of Drs. Lloyd and Lewis as having given him material assistance in the collection of these remains. He had found remains like the shagreen or tuberculated skin of some recent fishes, also extraordinary teeth belonging to a species termed *Stogodus Priscodontus*, and fish called *Seraphim*, by the quarrymen, from their seeming to possess only head and wings, to which the name *Pterigodus* has been given; also many others which M. Agassiz would soon have described and published.

*Heat in Mines.*—Mr. R. W. Fox stated, that at the Bristol Meeting of the Association he had been requested to make experiments on the Electricity of Mineral Veins. He had been unable to do much since that time—he had merely to mention, that he had made experiments at Middleton Teesdale, in the county of

Durham, and found a slight electric action in lead veins running east and west, other veins crossing these at right angles: in Goldbury mine he found it very trifling in lead veins occurring in sandstone. Indeed, he had generally observed, that the electric action was much more feeble in veins situated in sandstone and limestone than in those placed in granite and killas. He remarked a singular phenomenon in a coal-mine at Cockfield Fell:—It is well known, that coal is a bad conductor, but cinders the reverse; and in this mine he found an altered coal, resembling a cinder, which would not conduct at all; but he was able to render it a good conductor, by causing it to be heated. Mr. Fox then made some observations on the temperature of mines, and detailed some experiments. He had observed, that adventitious circumstances had the effect of reducing this temperature, so that experiments must be made independent of accident. He had accordingly placed one thermometer, in various mines, at a depth of three feet *in* the ground, and another *upon* the ground of the mine, and then marked the degrees; and he uniformly found a difference of one or more degrees between the two instruments, the imbedded one rising sometimes as high as 92°. Also, in a mine having an inclined lode, he placed on the floor of a horizontal gallery a pair of thermometers, one instrument imbedded, the other not, and found that, at a distance from the lode of twenty-four fathoms, the deep one marked 85¼°, and the other 84°; at ten fathoms off the lode they were respectively 86½° and 85°; in the lode itself, and upon it, 92° and 88°. Mr. Fox found the increase of temperature vary in different mines, and also in the rocks themselves, which he ascribed to the percolating water—killas being more porous, becoming sooner heated by water filtering through, than granite, which is more compact.

*North American Antiquities.*—Dr. Warren, of Boston, U. S., then offered remarks 'On some Crania found in the Ancient Mounds in North America.' Whatever related, he observed, to the lost nations of North America is interesting. The fate of a people which occupied the richest part of that country, for an extent of more than a thousand miles, is involved in the deepest obscurity. Nothing remains of their history, and we can gather no ideas of what they were and what they did but from the constructions existing in the territory they inhabited. These works are numerous, and scattered over the country, from the lakes of

Canada to the Gulf of Mexico. They consist of regular lines, having considerable elevations and great extent, of mounds or pyramidal eminences, and of spacious platforms of earth. These different works were adapted for fortifications, for places of worship, and for cemeteries. Within the last two years, reports, he said, had reached the Atlantic States of very extensive remains of structures indicating the existence of one or more considerable cities in the territory of Ouisconsin, formerly a northwest territory of the United States. The antiquity of some of the numerous works alluded to was great; there are circumstances which led him to refer them to a period 800 or a 1000 years back. The circular and pyramidal eminences seem to have been destined for two purposes: for places of worship and for cemeteries. Some of them contain immense heaps of bones, thrown together promiscuously, as after a bloody battle; in others the bodies are regularly arranged, and in some there are only one or two bodies: the bones in the last are usually accompanied by silver and copper ornaments, some of which are extremely well wrought. The crania found in these mounds differ from those of the existing Indians, from the Caucasian or European, and in fact from all existing nations so far as they are known. The forehead is broader and more elevated than in the North American Indian, less broad and elevated than in the European; the orbits are small and regular. The jaws sensibly prominent, less so indeed than in the Indian, more so than in the European. The palatine arch is of a rounded form, and its fossa less extensive than in the Indian or African, more than in the European, owing principally to a greater breadth of the palatine plate of the os palati. But the most remarkable appearance in these heads is an irregular flatness on the occipital region, evidently produced by artificial means. These peculiarities, with others more minute, give a character to these skulls not found in any living nations. Dr. Warren also stated that he had received other crania, which at first view he believed to be of the same race and nation, for they resembled them in all their peculiarities, more nearly than one Caucasian head resembles another; and he exhibited drawings and a cast in proof of the exactness of this resemblance; but these latter, he observed, were species of ancient Peruvian heads. Now the cemeteries of the ancient Peruvians are distant from the Ohio mounds more than 1500 miles, yet the facts stated above rendered it certain, in his opinion, that these nations were connected by blood, and rendered it probable that the northern race, being driven from their country by the ancestors of the existing race of North American Indians, retreated, after a long resistance, to South America, and gave origin to one of the nations which founded the Peruvian empire. Anatomy, also, he observed, showed that there was much resemblance between the crania spoken of and those of the modern Hindoos; and instruments, ornaments, and utensils have been discovered in the mounds, which bear a great resemblance to articles of the same description seen in Hindostan. The facts stated above lead him to the following inferences:—1. The race whose remains are discovered in the mounds were different from the existing North American Indian. 2. The ancient race of the mounds is identical with the ancient Peruvian. To these conclusions might be added others tending to support existing opinions, but which are hypothetical:—1. That the ancient North American and the Peruvian nations were derived from the southern part of Asia. 2. That America was peopled from at least two different parts of Asia, the ancient Americans having been derived from the south, and the existing Indian race from the northern part of the same continent.

*Cholera.*—Dr. Mackintosh then addressed the Section on cholera. He would state only facts, and show them, supported by a great number of preparations of parts taken from cholera patients soon after their death, mostly in the second stage,—collapse. He then spoke in favor of pursuing pathology, with a view of elucidating disease; but pathology, in combination with causes, symptoms, and treatment. He who did not pursue this method, was not a pathologist, but a mere morbid anatomist. He had dissected three hundred cases of cholera, in the first year of its appearance in a malignant form; two hundred and eighty of these died in the collapsed stage. It was a popular error to say, as many frequently do, that medical men know nothing of cholera. In every respect their knowledge on this subject is vast, and minute, and scientific, and practical. Their knowledge exceeds that on scarlatina, or measles, with which popular opinion thinks them well acquainted. In India the opinion is, that in cholera there is lost balance of the circulation: it was not so; there is no rigor, and never was a rigor, which there would have been, if the India opinion was true. There was a giving off of serum, and every vessel, arteries as well as veins of the body, every tissue was literally injected with black blood, which freely followed the knife on dissecting. Dr. Mackintosh now presented a great number of preparations, and paintings, and drawings, of the organs of the body afflicted with cholera. Many preparations were dried with the cholera blood in them, which was effected by submitting them, immediately on their removal from the body, to a stream of dry hot air, from apparatus constructed for that purpose. These accumulations were greater in some organs than others, often depending on the state of the patient's health previous to the attack,—if he had bronchitis, there would be the greatest accumulation. The bloodvessels were greatly distended: in a cast of a case taken from the abdomen, which he exhibited, the abdominal aorta was one inch in diameter, vena cava three-fifths, emulgent vein eight-sixteenths. The general anatomical characters, as shown by preparations of each organ, were accumulations of blood, ecchymosis, called by the French apoplexy; thus, if occurring in the lungs,—pulmonary apoplexy, petechiæ, and clots. In addition, we may mention some peculiarities in individual organs, as noticed by the lecturer. In the head, even the bones were vascular, and could not be bleached, but with great difficulty: arachnitis rare, pia mater loaded with blood and effusion, which caused many to mistake it for arachnitis; in the sinuses clots of blood and lymph, rendering in these cases recovery impossible. In the spinal marrow were, in sixty out of two hundred, deposits of bone on the theca; in the chest, pleura at first dry, as if exposed to dry air; in collapse it became unctuous; lungs very heavy, weighing 3 lb. 9 oz., to 3 lb. 11 oz.; pulmonary apoplexy frequent in consecutive fever, which fully explains the number of deaths from that fever after the cholera attack. In the abdomen, the mucous membrane ulcerated and softened, not always red, sometimes even white; the liver resembled that of dram-drinkers, the gall-bladder unusually distended with black bile; then many galls in numerous cases, in only one was the duct rendered impervious by them; the kidneys were diseased, as recorded by Bright, and from the papillæ could be pressed mucus; bladder contracted. As to the blood vessels, he wished to direct the particular attention of the Section to them; he would show, by many preparations, the diseased state of their inner coat, the organization of which was completely altered, so as to render them unfit for their functions, and this disease extended throughout the whole series of vessels, until it terminated in a kind of gelatinous pulp. Would this state of the vessels have considerable influence? and how far would it be concerned in producing that state of blood, always observed in cholera,—when the serum passes off, the blood becoming thick and black? Many of the French, and some English, thought the nerves in cholera, on its appearance, were comparatively not so vascular, and not much diseased otherwise; the par vagum, as it passes the subclavian artery, was enlarged like a ganglion. Even animals were seized with cholera, and presented the same morbid appearance as in the human subject.

Dr. Clanny could fully confirm all the observations of Dr. Mackintosh. Dr. Holland inquired, what name he would give to the affection of the bowels ushering in the cholera, and what was the nature of cholera? Dr. Mackintosh replied, watery diarrhœa; and he would have entered into the nature of the disease, if time could have been afforded him.

*Bust of Mæcenas.*—"It was long a cause of wonder and regret that no gem, medal, or statue of a man so illustrious, had ever been discovered. At length the Duke of Orleans, Regent of France, early in the last century, by a happy conjecture, fixed on one of the gems in his collection, an amethyst of small size, marked with the name of the engraver, Dioscorides, as being the representation of the head of Mæcenas. Another gem, bearing the name of Solon, the engraver, evidently representing the same person, was afterwards found in the Farnesian Museum; and a third of the same, a sardonyx, also engraved by Solon, has since been discovered in the collection of the Prince Ludovisi. The features given in these gems agree so well with all that has been handed down in the Roman classics, concerning the personal appearance and habits of Mæcenas, that the suggestion of the Duke of Orleans has been adopted by all subsequent antiquaries. A few years after the recognition of the head of Mæcenas on the gems of Dioscorides and Solon, both artists coeval with Augustus, an antique fresco painting was discovered in the ruins of the palace of the Cæsars on the Palatine Hill at Rome. This painting represents Augustus surrounded by his courtiers, conferring a crown on the Persian king Phraates, an event spoken of by Horace. In the front rank of the courtiers stands one, evidently the Prime Minister in the act of speaking, whose features strongly resemble those on the gems of Mæcenas above described. Next to him is Agrippa, who is readily recognized from medals, coins, and statues of him. Horace also is found in the group. A copy of this painting was bought by Dr. Mead, and brought to England by him; and an engraving of it may be seen in Turnbull's Essay on ancient Painting.

"This was the extent of antiquarian research and acquisition concerning Mæcenas during the last preceding half century, when, in the spring of 1830, a bust was found in an excavation made by Prof. Manni, at Carsoli, the ancient Carsuli, about seventy miles from Rome, on the Flaminian Way. This place is situated in what is esteemed the most beautiful and romantic district of the Roman territory, being near the cascades of the Nera, at Terni, and midway between the towns of Terni, Todi, and Spoleto.

"The bust was of colossal size, the same as that presented to the Society, of pure Parian marble, and perfect in every feature. On being cleared of its incrustation, the modelling of the work was seen to be of that masculine firmness which characterizes the style of the epoch of Augustus, excelling in what is called a broad manner,—the execution that of a master,—with the greatest severity and grandeur; the emaciation by age of the individual represented being faithfully preserved. The striking resemblance of the bust to the gems and picture of Mæcenas, was at once recognized by the most eminent antiquaries and learned men at Rome.

"It may be interesting to state, in further confirmation of the high value which has been set upon the bust, in Italy, as also because the circumstance enhances the gift of Prof. Manni, that it has been twice copied by Thorwaldsen. One copy was presented to the Grand Duke of Tuscany, and by him placed in the Hall of the Academy of Petrarch, at Arezzo, as being the presumed birth-place of Mæcenas; the other to the king of Naples, who caused it to be deposited in the Borbonico Museum at Naples."

*Objects of interest in Liverpool.*—In the museums, &c., of the Royal Institution, the attention is first directed to a series of ancient paintings, from the collection of the late Mr. Roscoe, illustrating the progress of the art. The department of Natural History is remarkable, and contains some rare specimens,—to which attention was drawn in the Zoological Section,—there is also a well-arranged Geological collection, particularly rich in specimens of the coal formation. The School for the Blind must also be specified as an institution on the largest scale, and admirably managed. The manufactures executed by the pupils are (some of them) exquisite for their neatness and finish. Besides these, we may mention the Botanic Gardens, recently removed from their old site in Mount Pleasant, in consequence of the rapid growth of the town; and the Zoological Gardens, or, in other words, Mr. Atkins' private menagerie, located and enriched by subsequent donations. The ground is agreeably varied, and the collection, which is extensive, contains, we believe, an unique specimen of the mule between the lion and the tiger. But the most interesting and individual things in the town, are some of the manufactories. One of them, Messrs. Fawcett & Preston's Foundry and Steam Engine Manufactory, is one of the largest establishments in the world. We saw it under favorable circumstances, for the proprietors were just completing the apparatus for a steam frigate, about to be launched by the French government. A stranger is most struck by seeing iron undergoing processes with which he is only familiar as connected with wood,—such as turning, planing, grooving, &c. An iron shaving, more than a yard in length, turned off as smooth and clear as if it were from a piece of wood, was a novelty which surprised most of the visitors. There are more than seven hundred workmen employed in this establishment; and though the labor is very severe, and would appear, from the number of metallic particles flying about, to be very unwholesome, we remarked that several of the operatives were very old men, and that none of them looked sickly. Contrary to the general opinion, we were assured that no difference is observed between the health of those who work in brass and those who work in iron. This is a gratifying circumstance, because brass and copper are daily coming more into use in the manufacture of marine steam-engines, being less injured by sea water than iron. The cannon-foundry was in more active operation than we should have expected in "these piping times of peace;" but we were informed that a large supply of artillery had been recently supplied to the Dutch government. Bury & Brancker's Foundry is the great manufactory for locomotive engines. It appeared to be more economical of its power than Fawcett's, and more ingenious in its contrivances and adaptations, though the works are not on so large a scale. With these we may mention Logan's chain-cable manufactory. In this, the most remarkable thing is, the apparent simplicity of the contrivances. Iron bars, heated, are twisted into links over double cylinders, and each link, as formed, is cut off by powerful shears. A bar crosses the middle of every link; this is formed of cast metal, and is inserted cold, when the link is welded into the chain. A slight blow is sufficient to secure the bar, for the link contracts as it cools down from welding heat. Each chain, when finished, is subjected to a severe trial; the chain is exposed, by means of a lever working on a centre, to a strain of more than twenty tons. Repeated fractures occur; and it is not until this test has been several times applied, that the chain is marked as perfect.

Without the town, the botanist finds a rich treat in Mr. R. Harrison's collection of Orchideous and Parasitic plants at Aigburth; and the geologist will visit Leasowe's Castle (an inn) for the sake of the remains of its submarine forest. This lies near the mouth of the Mersey, on the Cheshire side. It appears like a peat-bog, over which sand had been lightly sprinkled. We found several specimens of trees nearly perfect; and it was easy to determine their species, from the distinctness with which the form of the leaf is preserved in the peat. Within the house is to be seen the carved roof of the old star-chamber, which was brought from Westminster Hall. Nor must we forget to mention, as among the objects best worth seeing in the neighborhood, Mr. Blundell's Statue Gallery at Ince.

*Treasures of Knowsley, the seat of the Earl of Derby.*—The whole of the extensive premises were thrown open to the inspection of the visitors. In the galleries and rooms of the mansion were a fine collection of pictures; but, as our time was limited, we could not examine them with the attention they deserved. The extensive aviary contains many fine and rare birds and beasts. Some of these animals are permitted to range the grounds of the aviary unconfined, being covered in by wire-work, extending over many rods of ground. Among the Raptores we observed several fine vultures; among which were two species of Percnopterus; also the *Vultur Angolensis* of authors, and all the British eagles. Of the smaller birds, the Insessores,—a species of Lamprotornis, (never before seen alive in this country,)—a group peculiar to Africa, excited, by its brilliant coloring, elegant shape, and peculiar eye, the attention of all who saw it. The large eye is perhaps the most striking part of the bird, having a deep yellow iris surrounding a small and apparently black pupil, which contrasted remarkably with its dark purple plumage. There were many other rare and beautiful species in this order, especially one of the genus Euplectes. Of the Scansores there were several fine specimens; as *Nymphicus Novæ-Hollandiæ*, the *Psittacus Novæ-Hollandiæ* of Latreille, the *Paleornis Barabaudiæ*, the *Platycercus Stanleyii*, (named after the noble Earl,) the *Platycercus Bauerii;* also a living specimen of the red-billed Toucan, *Ramphastos Erythrorhyncus*. Amongst the Rasores were some red grouse—specimens of the Sand and Blackcock—which had been bred in the cage—a very rare circumstance. There were also a great variety of pigeons, and gallinaceous birds. Amongst the former was the beautiful and interesting passenger-pigeon, in great numbers, leading to the hope that it may soon become naturalized in this country. Of the Cursorial birds there were several fine specimens. Amongst the Grallatores, the Stanley crane *(Anthropoides Stanleyanus)* formed a striking object. It is a native of Africa, and has lately been brought into this country. Of the Natatores there were also numerous species. Two very fine pelicans were in close confinement, on account of the ravages they committed on the young of their colleagues, the Anatidæ, &c. Amongst the animals were several valuable species of deer and antelope; also various Marsupiata from Australia. The noble Earl accompanied the party around the aviary, and seemed to take great interest in his extensive collections.

*The Salt Mines at Northwich* also attracted a good deal of attention, and a party of about eighty set off on Saturday morning to visit them. According to previous arrangement, the gentlemen who were furnished by the President of the Geological Section with the necessary tickets, assembled at the railway station at a quarter before eight o'clock, but, owing to some mismanagement, the train appropriated to the party did not start until within a quarter of nine. A little after ten, the train, after a run of thirty miles, came to a stop, and the rest of the journey, a distance of about four miles, was accomplished in vehicles which were in waiting for the party. On their arrival at the works, they were conveyed, in succession, to the bottom of the mine in a basket lowered by means of a windlass, four descending together, and then conducted through the various parts of the excavation. There are two beds of the rock-salt, the lower one being exclusively worked, owing to its superior quality. The floor of the mine is 336 feet below the surface, and the portion of the saline mass removed is about 40 feet in height and extends over an area of 30 statute acres. A great number of successive strata of clay, more or less indurated, occur between the upper stratum of salt and the surface, and the two saline deposits are separated by analogous formations, the portions of those next the salt being intersected with little veins of the Sal gem, exhibiting a beautiful scarlet color, no doubt due to the presence of a small quantity of sesqui-chloride of iron. After having traversed the whole of the excavation, which was lit up in a most magnificent manner—several thousand candles having been employed for the purpose—the visitors were regaled within this subterranean palace with a very elegant *déjeuné*. We have seldom seen a company sit down in higher spirits, or to a better entertainment; and it is scarcely necessary to say, that when the health of the proprietors—particularly of Mr. Worthington, who had conducted the party from Liverpool, and also through the mine, was given, it was drunk with the utmost enthusiasm. The entertainment being concluded, some fireworks were exhibited, which lighting up the excavation with various shades of colors, produced effects which it is no exaggeration to describe as at once grand and terrific. "God save the Queen," and, at the suggestion of Mr. Porter, a psalm, having been sung immediately beneath the shaft, the whole party ascended, and returning by the same method of conveyance, reached the railroad station in Lime Street at five o'clock. While the party was below, Dr. Crook took occasion to make some geological remarks applicable to saliferous deposits, and drew attention to a peculiar appearance in several parts of the roof of the mine, from which he concluded that the salt originally solidified in globular masses, the crystallization proceeding from a centre. The temperature of the mine, which we should conjecture to be about 48°, was understood to be very equable throughout the whole year,—and not a particle of moisture was any where to be seen.

## Art. II.—*Memoir upon the Temperature of the solid parts of the Globe, of the Atmosphere, and of those regions of space traversed by the Earth;* by M. Poisson. Communicated to the Academy of Sciences, of Paris, at the Session of that body, held on the 30th of January, 1837.

**Translated from the French, for this Journal, by R. W. Haskins,* of Buffalo, N. Y.**

I propose to offer, in this memoir, an epitome of the principal results which are found in my work, entitled "*Théorie mathématique de la Chaleur;*" (1) to add thereto some new remarks, and to recapitulate the principles upon which these results are founded.

Near the surface of the globe the temperature, at every point, varies with the different hours of the day, and with the different days of the year. In considering these variations, Fourier, supposing the temperature of the surface given, has confined himself to deduce from this the temperature of a given depth; thus leaving unknown the relations that should exist between the exteriour and interiour temperatures. To determine these relations Laplace has assumed, for the exteriour temperature, that which is indicated by a thermometer exposed to the air, in the shade, and which depends, in an unknown manner, upon the heat of the air in contact with the instrument, upon the radiant heat of the sun, and upon that of the atmosphere. I have exhibited this problem under another point of view, more in conformity with the nature of the question; and I have proposed to determine the temperature of the earth, at a given depth, and upon a given vertical line, from the quantity of solar heat which traverses the surface at each instant. In any given place upon this surface, the quantity of heat varies, during the day, and the year, with that of the elevation of the sun above the horizon, and with the declination. I have considered it as a function disconnected from time, nothing while the sun is below the horizon, and expressed at all other epochs, by means of the horary angle and the longitude of the sun; and by known formulas I have transformed this function into a series of sines and cosines of the multiples of these two angles; and by means of the formulas of my preceding memoirs, I have subsequently determined, for each term of this series, the temperature of any depth whatever—which is a complete solution of the problem.

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* To Prof. Silliman.—*Dear Sir:* In the number of your Journal for April last, you gave a translation of one of Baron Fourier's papers upon the temperature of the Terrestrial Globe and the Planetary Spaces. A view of this subject, different from Fourier's, has recently been taken by S. D. Poisson, in his treatise upon Heat; and of which work the author has given a condensed outline in a paper that appears in *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences*, No. for 30th of January last.

Of the merits of either of these theories I assume not to judge; but as it seems highly probable that those who take an interest in these investigations would be pleased to see something of M. Poisson's views, I send, herewith, a translation of a part of the article in question. I have given but a part, as the paper is long, and much of it is devoted to mathematical demonstration, which I suppose would hardly interest the general reader, while those who wish such demonstration will, of course, seek it at length, in the author's work, referred to.

Respectfully yours,

Buffalo, Nov. 3, 1837. R. W. Haskins.

(1) 4to. Paris, Bachelier, 1835.

Of this temperature there are series of diurnal inequalities, of which the periods are of one entire day or a sub-multiple of a day; and annual inequalities of which the periodick times embrace a year or a sub-multiple of a year. Upon each vertical, the *maximum* of each of these inequalities is propagated uniformly downward, with a velocity dependent solely upon the nature of the soil; so that the interval comprised between the epochs of this *maximum*, for two points separated by a given distance, is the same, and proportional to this distance, in all places of the globe where the soil is of the same nature. At the surface, the interval which separates the *maximum* of one of these inequalities from that of the correspondent inequality of the solar heat, is invariable, with regard to geographical position; but it depends, at all times, upon the nature of the soil and the condition of the surface. It is the same with regard to the relation between these two *maxima*, of which the first is always less than the second; but the length of each vertical, the *maximum* of each inequality of temperature decreases in geometrical progression when the depths increase by equal differences; and the relation of this progression depends only upon the nature of the soil. If we examine, upon the same vertical, the inequalities of temperature, of which the periods are different, their expression will show that those which have the shortest periods are propagated with the greatest rapidity, and that they decrease, also, the most rapidly.

In general, the diurnal inequalities are insensible, at the depth of one mètre, (2) and the annual inequalities disappear at the distance of twenty mètres from the surface; while at about one third that distance this is reduced to an inequality of which the period embraces the entire year. At the depth of six or eight mètres the temperature offers, then, but one *maximum* and one *minimum* during the year; which have an interval of six months between them, corresponding to the epochs of greatest and least solar heat. Beyond a depth of about twenty mètres the temperature no longer varies with the seasons; or, at least, it can only experience secular variations which have not yet been observed.

Upon each vertical the inequalities of temperature, both daily and annual, are accompanied by an ascendant or descendant flux of heat, the quantity and direction of which varies with the time and the depth. The extent of these inequalities and of this flux of heat is not the same, in all latitudes; at the equator, for example, the annual inequalities mostly disappear, and consequently the temperature should there be very nearly constant, at a much less depth than at any other place.

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Near the surface of the earth the mean temperature due to the solar heat varies with the obliquity of the ecliptick, which enters into the function I have designated by Q. This secular inequality, like those which are daily and annual, is attended with a variation in the direction of depth, which we are not able to determine with accuracy, in default of knowing the expression of the obliquity of the ecliptick, in the function of time; but the data we have of the extreme slowness of the displacement of the ecliptick, and of the minuteness of this displacement suffice to show that the variations of terrestrial temperature, arising from this cause, are very feeble, and can therefore but slightly influence the observed increase of temperature, at augmented depths. Fourier, and afterwards Laplace, attributed this phenomenon to the original heat which the earth has still preserved, and which they suppose to increase constantly, from the surface to the centre of the globe; so that, while at the centre there is a temperature excessively elevated, yet near the surface the heat, from this cause, is scarcely perceptible: that in virtue of this primitive heat, the temperature, at this time, is more than 2000 degrees, (3) at a distance from the surface not exceeding the one hundredth of the earth's radius; while at the centre of our globe this temperature surpasses 200,000 degrees, estimating it according to the ordinary formulas which relate to solid, homogeneous bodies. (4) But, although this explanation has been generally adopted, I have shown, in my work, the difficulties which it presents, and which, it appears to me, render it inadmissible. I believe I have there shown in what manner the earth must have long since lost all heat which it may primitively have had; and subsequent reflection having confirmed me in this opinion, I shall present it here with more precision and assurance than at first.

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(2) The mètre is = 3.2808992 English feet.

The almost spherical form of the earth and planets, and their depression at the poles of rotation, leave no room to doubt that these bodies were originally in a fluid state. In the problem having for its object the determination of the figure of these bodies, geometricians consider them, in fact, as liquid masses, composed of layers, each having the same density throughout all its extent; and the whole revolving round the same axis, of constant direction, with a known and constant velocity. The density decreases, from one layer to another, in receding from the centre towards the surface, either because these heterogeneous layers have distinct densities, and are regarded as incompressible, and that the most dense have sunk towards the centre for the stability of the system; or rather because, according to the opinion of D. Bernouilli, subsequently revived by Thomas Young, all these layers were formed of one homogeneous liquid, susceptible of a certain degree of compression, and of which the density consequently increases, in approaching the centre, by reason of the pressure, also increasing, which the liquid exercises upon itself. In either case they suppose the entire mass of liquid, after numerous oscillations, arrived at a permanent figure, which was determined in this state of fluidity, and that the liquid subsequently preserved this figure while passing to a solid state. The solution of this problem of hydrostaticks requires only a knowledge of the temperature of the liquid; but now, if we suppose that this heat was very great, and much superiour to the temperature of the regions of space surrounding the planet, we see not what exteriour pressure there could have been which prevented the liquid from dilating itself to a state of vapour, instead of passing from a liquid to a solid state: and if it was possible that the layers near the surface had commenced, through condensation, to assume the solid state, before the interiour layers had lost their primitive heat, we can no more clearly understand how these last, by their tendency to dilation, of which we understand the power, should not burst the solid, exteriour envelope as often as formed. It is farther to be observed that this high temperature of our planet, in the liquid state, is a gratuitous assumption of which it would be difficult to find an explanation. (5) It is true that when a body is at first a liquid, more or less compressible, of which the layers would augment in density, in going from the surface to the centre, and terminate by passing to a solid state, by reason of the pressure from without, this condensation and this change of condition would develope a great quantity of heat; but it is necessary to observe that in this view of the subject the solidification would probably commence at the centre of the mass: the nucleus, thus solidified, would become a focus of heat, which would raise the temperature of the immediately surrounding layer, still in a liquid state; this layer, thus heated, and its density diminished, would be elevated, and its place supplied by a new layer which, in passing to the solid state, would radiate heat in like manner, and so in succession, until the entire mass should have become a solid. In this manner the solid nucleus, gradually augmenting, would communicate, to the parts still liquid, the quantities of heat successively disengaged from newly solidified layers, while, by reason of the mobility of the liquid particles, these quantities of heat would be carried to the surface, where the whole would be dissipated, by radiation, through the surrounding space. While thus passing to a solid state, the liquid mass would lose all the heat developed by this change. But this may be better understood in ascending to the probable cause of the primitive fluidity of the planets.

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(3) Centigrade division is that employed by the author, throughout his work.

(4) At page 428 of the author's *Théorie Mathématique de la Chaleur*, he has the following passage:

"At the centre, and throughout the greater part of its mass, the materials of which the earth is composed would then be in a state of incandescent gas; yet so condensed that their mean density would surpass, five times, that of water. To contain these, at such a degree of condensation and of heat, an extraordinary force would be necessary, of which we can form little idea; and we may doubt if the solidified layers of the globe would have thickness and cohesion sufficient to resist the dilating power of these interiour, fluid layers."

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(5) Some interesting remarks upon central heat occur in Lyell's Geology, American edition, 1837, vol. 1, p. 452, and onward. The last English edition, of which this one is a copy, was published during the present year; yet it is probable the author had not seen M. Poisson's Theory of Heat, as he quotes both Fourier and Cordier, and controverts their theory, but without mention of Poisson.

This we may illustrate by reasoning on the known hypothesis of Laplace, upon the origin of these bodies, namely, that they are portions of the sun's atmosphere, which it has successively abandoned, in concentrating itself around that body. The earth was, then, primitively, an aëriform mass, of very great volume, relatively to what it now is, and formed of the different materials, solids and fluids, of which it is now composed, which were then in a state of vapour, that is of an aëriform fluid, of which the density could not surpass a given *maximum*, proportional to its degree of heat, and which would become liquid or solid according to the augmentation of the pressure it experienced, without changing its temperature. That of the earth would depend, then, upon the point it should occupy in space, and upon its distance from the sun; and might be more or less elevated. But independently of the attractions and repulsions which take place only among particles near each other, and which produce the elastick force of aëriform fluids, equal and contrary to the pressure they sustain, the particles of the earth were also subject to their mutual attraction, in the inverse ratio of the squares of their distances; and from this force there resulted, upon all the layers of the fluid mass, a pressure, nothing at its surface, increasing from the surface to the centre, and which, at the centre itself, becomes exceedingly great, surpassing 100,000 times, the weight of the present atmosphere. It is this increasing pressure, and not an exteriour temperature much lower than that of the fluid, which has successively reduced all the layers to a solid state, commencing with those at the centre, and continuing from one to another, until nothing remained except the matter composing the oceans and the atmosphere of the present day. But this reduction has not been instantaneous; for a certain period of time was necessary for each layer to approach the centre, towards which it was urged, by the pressure it experienced, and which was the exciting cause of this movement. Now we may readily infer, when we call to mind the almost infinite velocity of radiation, that time enough has elapsed for the different layers of the earth, in passing to a solid state, to have lost all the heat developed during their change, and which escaped, by radiation, through the superiour layers, still in a state of vapour; so that long prior to the present period, the last trace of this heat, however great it may have been, had disappeared. An effect similar to that we are now considering would result, for example, if we produce a horizontal cylinder, of great length, closed at the ends, and filled with steam at the temperature of the exteriour, and at the *maximum* of density. In this position of the cylinder, the weight of the fluid would exercise no influence, and the pressure would be the same throughout the mass; but if we place this cylinder in a vertical position, the weight of the various layers of the fluid would produce a pressure, increasing in the direction of gravity, that of each being added to the preceding; and in this manner the several layers would become condensed to a liquid, in regular succession. The movement of each layer, during its descent, it would be difficult to determine, but, the time of its duration would certainly be sufficient for the latent heat of the liquefied vapour to escape, by radiation, if we suppose the sides of the cylinder, or even only its top to oppose no obstacle to radiation, or to be permeable to radiant heat; and in this manner the water of which the vapour had been composed would not become heated, but would preserve the temperature of the exteriour.

In discarding, then, the opinion that the observed increase of temperature of the earth, with the increase of depth from its surface, is attributable to the original heat our globe may have had, I have proposed another explanation of this phenomenon, founded upon a cause of which the existence is certain, and which may certainly produce an effect similar to that which we observe. This cause is the inequality of heat in the regions of space traversed by the earth, in its movement therein, with the sun and all the planetary system. (6) The temperature of any given point of space, or that which would be indicated by a thermometer placed at that point, is produced by the radiant heat from the stars, which traverses space in all possible directions. These stars form, around each point of space, an immense circumference, closed on every side; since, from such point, in any direction, whatever, if a right line be produced, of indefinite extent, it will terminate by encountering a star, either visible or invisible. Now, whatever may be its form and its dimensions, if this enclosure had, throughout, the same temperature, that of all space would be the same; but this is not the case: the heat as well as the light of each star is maintained by some peculiar cause, and these incandescent bodies tend not, therefore, to a uniformity of temperature, by the exchanges of radiant heat. This admitted, it follows that the temperature of space varies, one point with another; yet by reason of the immensity of the stellary enclosure, it is only by comparing the temperature of points greatly distant from each other that this variation would become perceptible. In distances no greater than that traversed by the earth, in its annual orbit, the temperature of space would be sensibly identical; but in regions so elongated as are parts of that through which the sun and the planets are carried, in their common movement, this would not remain the same; and the earth, in common with all the other bodies, would experience corresponding variations of temperature. Still, from the magnitude of its mass, it may readily be seen that in passing from a heated to a colder region our globe would not readily lose, in the second, all the heat it had imbibed in the first; but, like a body of considerable volume that we might transport from the equator to our climate, so the earth, on arriving in a more frigid region, would present, as we see the earth really does, a temperature increasing from the surface towards the centre. The opposite would take place when the earth, by continuation of its movement in space, shall pass from a cold region to one of a temperature more elevated.

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(6) Has such a movement been recognized?

Both the extent and the periods of these variations are unknown to us; but, like all the inequalities of long periods, like those, for instance, arising from the secular displacement of the ecliptick, if they were sensible, these variations will extend themselves to very great depths, although not to the centre of the earth; nor, perhaps, to a distance from the surface which will bear any considerable proportion to the radius of our globe: still, the increase or decrease of temperature, in a vertical direction, which will accompany them, will extend far below the utmost depths accessible to us; where they will attain their *maximum*, and beyond such point will disappear. We may assume, upon the inequalities of temperature of the regions of space traversed by the earth, an infinity of hypotheses which could serve but as examples of calculations, proper only to show how these inequalities should influence the temperature of the surface of the globe; and that this influence may be sensible it is only necessary that the consecutive *maximum* and *minimum* of the heat of space differ widely, and that they be separated by very long intervals of time.

According to the example which I have arbitrarily chosen in my work, the temperature of space, in one million of years, would pass from + 100° to − 100°, and return again from − 100° to + 100°; and if we should farther suppose that it is now at its *minimum*, an increase of the temperature of the earth, in a vertical direction, from the surface towards the centre, very nearly equal to that we observe would be the result. This increase will be sensibly uniform, at all accessible depths: it will vary beyond; and at a depth of about 7000 mètres the temperature of the globe will attain its *maximum*, and surpass, by about 107° that of the surface: beyond this it will diminish, so that at about 60,000 mètres from the surface the influence of the inequalities of the temperature of space will have entirely disappeared. In the same example the temperature of the surface of the globe, 5,000 centuries since, would have surpassed that of the present day little less than 200°, and it will again be the same when another 5,000 centuries shall have elapsed; a temperature that must have rendered, and will again render the earth unhabitable to the human species: but 500 centuries before, and 500 centuries after the period in which we live, the temperature of the surface would not exceed, by more than about 5°, that which we now witness.

Such is, in my opinion, the true cause of the augmentation of temperature which we experience upon each vertical line, from the earth's surface, towards its centre, in proportion to the distance from that surface. In this theory the mean temperature of the superficies varies with extreme lentitude, but incomparably less than the portion of temperature which might be due to primitive heat, if that was still sensible. Farthermore, this variation is alternative, and thus is able to concur to the explanation of the revolution to which the exteriour layers of the globe have been subject; while, on the contrary, such portion of the temperature as might be due to the other cause diminishes constantly, and this without alternation. If the increased temperature observed in a vertical direction should really be due to the original heat of the globe, it would follow that, at the present epoch, this primitive heat would augment the temperature of the surface itself by a small fraction of a degree; but, that this small augmentation might reduce itself, for instance, one half, it would be necessary that more than a thousand millions of centuries elapse; and if we desire to retrograde to an epoch at which this may have been sufficient to produce the observed geological phenomena, it would be necessary to ascend the stream of time such an immense number of centuries as would alarm the most fearless imagination, whatever idea may otherwise be entertained of the antiquity of our planet.

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There is reason to believe that, of stellary heat, equal quantities are not transmitted to us from all the various regions of the heavens. If we imagine a cone, extremely pointed, which has its summit in some point of the surface of the earth, and which is prolonged to the fixed stars; by reason of the very great distance of the earth from these stars, this cone would embrace an immense number of them; and it is the mean of the quantities of heat that they thus emit which I take for the intensity of stellary heat in that direction. Now it is out of all probability that this intensity would remain the same, if we suppose this cone moved round its summit, and pointed, successively, in every different direction; or if we remove its summit, and transport it, in succession, from one place to another upon the earth's surface: still the most delicate experiments would alone be able to disclose to us those parts of the heavens from which the stellary radiation is of the greatest or least intensity; nor has observation hitherto aided us, in the least, upon this subject—one of the most interesting of celestial physicks. At the different hours of the day, the total quantity of stellary heat which reaches any point of the earth, emanates from all the celestial bodies situated above the horizon of such point, and it may therefore vary, in any given time, at one place with another, and cannot be the same, for example, at the equator and at the poles. The quantity of stellary heat which comes to us in the same interval of time must also be very unequal in the two hemispheres; and this inequality is one of the possible causes of the difference of the mean temperature of the northern and southern hemispheres.

In relation to the physical constitution of the atmosphere, the laws of the decrease of the quantity of vapour, of density, and of temperature, proportioned to elevation above the horizon are not accurately known. The decrease of one degree for 172 mètres of difference in vertical elevation, as drawn from the aërostatick experiments of M. Gay Lussac refers to the temperature indicated by the thermometer suspended in the open air, but this does not disclose to us that of the layers of air themselves, of which the actual temperature determines the radiation, and perhaps exercises an influence upon the absorbent power. All we know, in this repect, is, that the mean temperature of the air in contact with the surface of the globe should equal that of the surface itself; and that, at the superiour limit of the atmosphere, the actual temperature of the fluid cannot surpass that of its liquefaction to such degree as that the density should be reduced. The first condition results, as previously stated, from the continual contact of the inferiour layer of the atmosphere with the *earth's surface*; the second is a necessary condition to the equilibrium of the fluid mass, and independent of the general equation of this equilibrium.

In fact, if we divide this mass into concentrick layers so infinitely thin that the weight of each layer should be insensible, the *weight of* an interiour layer would suffice, nevertheless, to counterpoise the difference of pressure which would be exercised, in opposite directions, upon these two faces, which has for its extent the elastick forces of the two adjacent layers; but, the most elevated layer experiencing no pressure upon its superiour face, could not, by its weight, balance the pressure exercised upon the other face, if this were appreciable; consequently the elastick force of the air should be nothing at the limit of the atmosphere, of which the distance, from the surface of the earth, is much less than the distance at which its centrifugal force would destroy its gravity. Now, the elastick force cannot be reduced to zero, because it decreases *only* in the ratio of the density, according to the law of *Mariotte*; and however reduced, therefore, the density of the air may be, it will retain an elastick force by virtue of which it will be still farther dilated; and the atmosphere thus deprived of any fixed limit, would extend through all space. It cannot be objected that the atmosphere would be maintained in place by the pressure of the ether upon its superiour surface; for this ether would penetrate into the air, and its elastick force from within would equal that from without, so that this power would be balanced. It is, then, through the agency of cold that the superiour layers of the atmosphere are deprived of their elasticity. Near its superiour surface the temperature of the air should be that of the liquefaction of this fluid, and the layer of liquid air should be of such thickness as that its weight may equal the elastick force of the inferiour air, upon which it rests. If the molecular force should disappear in this exteriour layer, in consequence of the mutual distance of the molecules, rendered very great by the extreme rarefaction of the fluid, this layer could not support itself upon that immediately beneath; the gravity of its molecules towards the earth could not be destroyed except we suppose a velocity of rotation and a centrifugal force communicated to them greater than to those of this other layer; and this experiencing no exteriour pressure, should be considered the extreme layer of the atmosphere, which can only lose its elasticity by liquefaction.

We know not, accurately, the temperature necessary to a liquefaction of atmospherick air, at its ordinary density, and still less in the rarefied state of its superiour layers; but there can be no doubt that it is extremely low, and perhaps still more so in a case of feeble density. This temperature, which is indispensable to a definite termination of the atmosphere, is, it appears to me, the true cause of the excessive cold of its superiour part, and of the decrease of the heat of its successive layers, in proportion as we ascend from the surface of the earth. This phenomenon, then, would still take place if the atmosphere were perfectly in repose; it is not therefore owing, as has been sometimes supposed, to an ascensional movement of the air, in which this fluid is dilated by the diminution of pressure, and becomes cooled in consequence. Those who have given this explanation have not observed that this upward movement is accompanied by another, in the contrary direction, and that in this double movement the masses of air mingle together, and traverse each other, mutually, so that it would be difficult to decide whether the final result should be an augmentation or a diminution of the density and the mean temperature of the whole. But we must not lose sight of the fact that this extremely low temperature of the superiour layer of the atmosphere is that of the air itself, and not that which would be indicated by a thermometer placed therein. This might be much more elevated; it would arise from the contact of the air, and from the radiant heat of the stars, sun, earth and atmosphere; but the first of these could have little influence, from the extreme tenuity of the fluid; so that the mean temperature indicated by the thermometer would differ very little from that which it would indicate if it were removed from the atmosphere and placed a short distance above it.

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NOTE.—In the proceedings of the Academy, on the 17th of April last, the following passage occurs:

"M. Poisson presented a supplement to his work, entitled *Théorie Mathématique de la Chaleur.* This supplement is constituted of the *Memoir upon the Temperature of the solid parts of the Globe, of the Atmosphere, and of those regions of space traversed by the Earth,* which was inserted in the Compte Rendu de la séance de l'Académie of the 30th of January last; and to which the author has added several notes, relating, principally, to the temperature of the earth and of space, at different epochs. One of these notes contains the complete determination of the laws of refrigeration of a sphere of very great diameter, as the earth, for example, which has not before been deduced from theory. Another contains an example of the calculation of the temperatures and densities of the atmospherick layers, regard being had to the propagation of heat from layer to layer, and to the conditions which terminate the atmosphere; that is, to the condition of an elastic force which is nothing in the upper layer of the atmosphere; which can only result from a temperature of this layer proper to its liquefaction."

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## ART. III.—*Miscellaneous Remarks on certain portions of the Geology of Maine, in a letter from* Dr. CHARLES T. JACKSON, *to the Editor, dated Boston, Nov.* 13*th*, 1837.

TO PROF. B. SILLIMAN.

*Sir*—I HAVE lately returned home after spending five months in the continuation of the geological survey of Maine, two months of which time has been spent in the forests of the public lands of that state.

The facts which we have observed are of a most interesting character, and much time and great labor will be required, in digesting and setting in order the various observations which we have collected.

My first object was to continue the outline survey of the sea coast, from Blue hill to the New Hampshire line. When this was completed, I made a sectional line across the middle of the state inland, parallel to the sea coast. Then I made a sectional survey, from the mouth of the Penobscott to the gulf of the St. Lawrence.

After this, I followed the east branch of the Penobscott and the Lebois to their sources, and passed over to the Aroostook river, and followed it down to its confluence with the St. John's. I also surveyed the greater portion of the New Hampshire line of Maine. By following this order, the most perfect outlines of the geological structure of the country have been obtained, and the facts are very important in relation to both science and the arts. I have had also to perform in many of my sections, the duties of geographer and topographical engineer, since the country was almost wholly unknown, and was erroneously laid down on the state maps. Difficult and laborious has been the task; but I have every reason to feel satisfied, that the work was as carefully executed as the time and means in my hands would allow.

I took great pains to ascertain accurately the altitude of every important point by barometrical levelling, and the precautions taken ensured accuracy in the results. Having procured two of the best English barometers that could be obtained, I took great care to bring them to the exact standard, and regulated the thermometers by a perfect standard French instrument, made expressly for me by Collardeau. I then established a line of barometrical correspondence across the state; this was done by making an agreement with a number of gentlemen to keep exact registers of their instruments, the difference between theirs and mine having been carefully noted. Daniel Sewall, Esq. of Kennebunk, Rev. Solomon Adams, of Portland, Prof. Cleaveland, of Brunswick, Mr. R. H. Gardiner, of Gardiner, and O. Frost, Esq. of Bangor, were engaged to keep the required registers, and were very attentive and exact in their observations. Now the object in this plan you will readily understand, was to be perfectly sure that there was no local difference in the atmospheric pressure, or if there was any, to have it noted and allowed for. When altitudes are taken with all these precautions, we can rely upon them with perfect confidence. The various tables will be published in my report for this year.

I was more especially desirous of learning the height of the tertiary deposits in various parts of the state, since they will give us the elevation formerly held by the ancient ocean which made these fossiliferous deposits. I also wished to know the height of the land for the purpose of making sections of the state in profile. I have measured also the altitude of the most remarkable mountains in the state.

I have collected, to illustrate the geology of Maine, about seventy large boxes of excellent specimens of rocks and minerals, all of which, with their localities, were labeled on the spot, the moment they were taken,—each assistant being supplied with a bottle of softened gum tragacanth and paper for the purpose. There are abundant proofs collected, demonstrating the valuable mineral resources of the state. Statistical information has also been obtained, where it was possible, respecting the precise amount of value received by the sale of quarry stones, lime, marble, &c.

I also examined into the geological origin, nature, distribution, chemical composition, and capabilities of the various soils of the state, and the information attained will form a chapter on agricultural geology,—a most important subject, too generally neglected, but one full of instruction.

We have collected a great number of observations relating to the interesting subject of diluvial transportation and diluvial furrows. How much I should be delighted could any of those geologists in Europe, who feel sceptical on the subject, visit with me the numerous and most decided proofs which are presented in Maine, demonstrating the general direction and power of the diluvial current. I think that no reasonable person would venture to stand in opposition to the facts which we can present in illustration of this doctrine. I do most ardently wish, that Mr. Lyell and Dr. Boué, two excellent geologists, who do not feel disposed to admit the results adduced by our very able friend, Prof. Hitchcock, and others, would come over to this country and see for themselves, the most tangible proofs that were ever adduced.

I have found strong diluvial marks extending across the whole state of Maine, and the transported boulders are always traced to their origin in the direction of the furrows worn on the rocks. There was never a better country than Maine, in which to settle this important question, for there are wide belts of rocks of different kinds, dividing the state into distinct geological sections. I cannot take time now to enter into details, but will observe, that the direction of the diluvial current in Maine, is proved to have been from N. 10 to N. 20° W. to S. 10 to 20° E. or the mean will be N. 15° W. to S. 15° E. This too is the uniform direction of those diluvial accumulations called "horsebacks," which abound in the state, and form long ridges like rail road embankments, frequently extending for many miles.

While engaged in the survey of the Aroostook river, I discovered another powerful bed of rich red hematite iron ore, thirty-six feet wide, running through a thickly wooded country, where it may be advantageously wrought by means of charcoal, into the most valuable kinds of iron and steel. I have also discovered several valuable beds of magnetic iron ore, which will doubtless be wrought so soon as their value is known to the people interested. Limestone, marble of great beauty, granite, mica slate, and other valuable quarry stones abound.

While exploring the soils of York and Oxford counties, I was surprised to find, that, although the country appeared to be composed wholly of granite and gneiss rocks, the soil was wonderfully rich and produced admirable crops of wheat. This was not to be expected from a purely granite soil, and on more minute examination, I found that the gneiss on the sides of most of the granite mountains alternated with thin beds of limestone, from an inch to a foot in thickness, and resembled so closely the gneiss in color as to have at first escaped my observation. This at once accounts for the fertility of the soil, for it is made up of decomposed gneiss and limestone as well as granite rocks, and hence is well adapted to the cultivation of wheat.

The soils around the Kennebunk river are generally impregnated with sulphate of iron from pyrites, and require liming to amend them and render them fertile. But little attention has been paid to the nature of soils by our farmers, and this is the reason why they do not succeed better in amending them.

The manner also in which the layers of clay, sand, and other soils are distributed is important, and comes within the province of geology. I noticed in one town a spot where this was very evident, the soil being sandy, and resting on a clay substratum. In one part of the field the corn was then four feet high, and in the other only two, although the soil was exactly alike and the manure the same in nature and amount. The cause was traced to the difference in the depth to a certain stratum of clay which was near the surface, where the corn was luxuriant, and deep below, where the corn was feeble. So the manure sank in the latter case too low to be reached by the roots of plants.

I have discovered the *actual bituminization of peat* in a bog, at Limerick, in Maine. The substance is in fibrous masses like brown coal, and burns with yellow flame and smoke. It is found ten feet from the surface of the bog. When this substance is heated in a glass tube, it gives out an abundance of coal gas, and bitumen distils off freely. This, I believe, is the first instance *in which peat* has been observed actually passing into bituminous coal. I have also found another curious fact, viz. three beds of anthracite coal in *slate that has been melted into hornstone by a great mass of trap rocks.*

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## Art. IV.—*Popular Notices of Mount Washington and the vicinity;* by G. W. Nichols,—*with additional remarks by the Editor.*

Bedford, N. Y., Jan. 10th, 1838.

TO PROF. SILLIMAN.

*Dear Sir*—Having made a short tour through New England, in the summer of 1836, I now send you for the American Journal, some notices of scenery and other objects, which fell under my observation while passing through the White mountains of New Hampshire.

On Wednesday, August 17, 1836, I left Bath, (a neat and enterprising village on the Amonoosuck river,) for the White mountains. The ride from this place was truly delightful; for it was under a clear sky, and very agreeably diversified by beautiful and splendid scenery. Our road lay, a part of the time, along the picturesque banks of the Amonoosuck, and it led us also over hills and through dense forests of stately evergreens. The level country, which had followed us along the banks of the Connecticut, was soon exchanged for gradual undulations, of a region with a barren soil, which continued to rise higher, and spread wider, until we reached the valley lying near the base of the mountains. A very perceptible difference in the temperature could be felt, as we gradually made our way upward; and, notwithstanding it was now not far from the middle of August, the scanty crops had nearly all been destroyed by the frost. Indeed, the weather was so cold, that blazing fires were found at most of the inns where we stopped. The sparse population of the mountains is obliged to depend upon the neighboring country for their agricultural supplies, and all that is not consumed, finds a market in Portland. Now and then, as you pass along, the eye rests upon a little strip of cleared land, composing the farm of some mountaineer. There was one which peculiarly arrested our attention. It embraced, along with a few acres of ground, a small rude hut, consisting of pine logs piled one upon the other, and made tight by means of plaster. A roof of rough boards was thrown over the logs. What a contrast between this rude habitation and the splendid mansions of our cities! Science and commerce nourish the arts, and the arts make the difference between the mountain hut and the city palace.

The scenery, as you approach the mountain, increases in grandeur and sublimity. Vast and interminable ridges of mountains rise on all sides, one above another, until they seem to be blended with the distant horizon. The white peaks of these mountain groups, appearing as if snow clad, tower above all other objects and hide themselves in the clouds.

### *Ascent of the Mountain.*

On Thursday morning, August 18th, our company (consisting of three persons and the guide) left the dwelling of our host at the early hour of six. Thence we proceeded, as fast as our horses could carry us, through forests, over swamps and rugged steeps, by a path filled with mud, stones, and roots of trees. Arriving at some distance from the foot of Mount Washington, our horses were tied to trees and thence we proceeded on foot. The ascent was at first gradual, but soon became in the main exceedingly steep, and we scrambled on over rocks, piled one upon another, and answering for rude stairs. Nearly half our journey from the foot of the mountain was through a pine forest, and the rest over rocks and barrens. The whole distance ascended on foot is three miles. About half way up, I discerned a small shrub adhering to the rocks in the manner of a vine, and named by our guide the dwarf spruce. This was the last appearance of vegetation. The summit, for the distance of half a mile on all sides, is composed of immense rocks, promiscuously heaped together, while the view which it affords, is beyond what the most vivid imagination can conceive. In this elevated region, soft, silky clouds were seen floating around and beneath. And no object could be more splendidly gorgeous, than one of these clouds when illumined by the sun. The barrenness of an unbroken winter, whose bleak winds are whistling around, rests on all the scene. Towards the west, north, and south, it might be said of the mountains,

"Like Alps on Alps they rise,"

until, on the east, their summits mingle with the heavens. An immense valley stretches out before you, in which the Saco may be distinctly seen pursuing its way to the ocean. The furrows and ruins of a number of avalanches too, are visible in the sides of the mountains. These possess a melancholy interest from the fact, that one of them, about eleven years since, borne onward from the mountain top by a sudden deluge,* swept away an entire family, (nine in number,) into the Saco, where their bodies were found among the earth, and stones, and trees, the ruins transported by the flood. On the following day, after my return from the mountain, I stopped to view the scene of this most tragical occurrence. It lies on the public road to Portland, in a stupendous defile between the mountains, commonly called the 'Notch.' The two mountain ridges here approach very near, and there is only room for the small river Saco and a road, with a few patches of cultivated ground. The house in which this unfortunate family resided remains, and is now as it was then, an inn. Those, who at that time administered to the necessities of the traveller, are now no more! It is said that they ran out of the house during the night, supposing that the avalanche was coming directly upon them. Had they remained in the house they would have been safe, and in emerging, they ran to destruction; for at the distance of only a few yards from their dwelling, the fatal torrent overtook them and swept them away.* The view here presented of the mountain sides, on the right and left, is terrific in the extreme. Enormous ledges of rock hang over them, frowning upon the traveller below. Beautiful cascades likewise may be seen, tumbling down over these cragged steeps, and whirling in crystal eddies in the deep fountains which they have worn in the rocks. I spent some time in searching for quartz crystals, which are frequently found among the hills. They are of the brown or smoky variety, sometimes very large and beautiful, and are kept for sale at the public houses. After travelling some distance amidst such scenery as this, we at length emerged from the region of mountains and plunged again into a wide forest, which intervenes between the 'White hills' and the city of Portland.

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* So violent was the friction of the descending masses of rocks, that streaks of light, filling the air with an electrical odor, flashed along their paths, illuminating the palpable darkness of that dreadful night.—Ed.

### *Remarks by the Editor.*

There are many facts connected with the physical features of these mountains that are worthy of description. Among them no one is more remarkable, than the trap dykes which frequently intersect the granite mountains, cutting them from top to base, and downward, into profound and unfathomable depths; their dark massy walls form a striking contrast with the white, gray, or red granite, or granitic schists, through which they have forced their way. But we leave the description of them to Prof. Hubbard, of Dartmouth College, whose account will be found in this number of our work.

Being for the second time, among the White mountains in the last week of August, of the late season of 1837, I ascended Mount Washington on the first of September, in company with my son and two gentlemen of Boston.

The day was mild, and in the main the atmosphere was clear, with occasional flying clouds, flitting over the sun, which frequently burst out with autumnal splendor, and illumined all the magnificent mountain groups, and valleys, and defiles, that cover this truly alpine region. The traveller who undertakes the ascent of Mount Washington, must lay his account to severe fatigue.

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* Some additional particulars of the catastrophe of the Willey family, alluded to by Mr. Nichols, are mentioned by me, in Vol. XV. p. 220, of this Journal. I visited this place in 1828, with some friends, two years after the event.—*Ed.*

Ladies sometimes go on this adventure, but it were better, in my judgment, that they should not attempt it. It is scarcely possible to afford them any material assistance; they must struggle almost unaided, first through the arduous forest-ride, where none but the practiced and wary-footed animals, that are trained to the service, can carry them in safety; and safety depends, very much, upon permitting the horses to wend their own way, unmolested by guiding, through the deep mud holes, the tangled roots, and the projecting stones and timber, which, notwithstanding all that has been done, (and much labor has evidently been expended here,) still obstruct no small portion of the journey through the woods. There are, however, only two or three miles that are thus anxious and fatiguing; the rest is a plain and open road, the whole distance from the hotel to the foot of the mountain being six miles. When the horses are abandoned, then commences the severe labor.

When we began our ascent, and during most of its progress, *I insisted* that the party should halt and sit down every twelve or fifteen minutes; three or four minutes of rest was, in general, sufficient to restore a natural respiration and to equalize the circulation of the blood, both being much disturbed by an unceasing ascent, and the muscles are thus overstrained and exhausted; the respiration becomes laborious and the circulation is hurried on, especially through the lungs, with oppressive and even dangerous celerity. These precautions are of the utmost consequence in ascending mountains, and by the neglect of them and especially by yielding to a false pride of vigor and hardihood, and to an equally false shame of being thought effeminate, health is hazarded, and sometimes both health and life are destroyed.* If ladies insist upon making this ascent, their dress should be *adapted to the service*, and none should attempt it but those of firm health and sound lungs, and although this remark applies to them in a peculiar manner, it is decidedly applicable *also to those* of the other sex.

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* An eminent writer and orator, one of the brightest ornaments of this country, assured me, that he never recovered from the effects of a rapid ascent in his youth, up Mount Ascutney, near Windsor, in Vermont, which is not half so high as Mount Washington.

A very lovely and accomplished young lady, of fine talents, but of a spirit which only rose with the difficulties to be encountered, is said to have laid, in this very ascent up Mount Washington, only a few years since, the foundation of an illness which cut her off prematurely in a foreign land. I knew her well. I may add also, Our younger friends had been persuaded to make packs of their great coats, being assured that, although the world was smiling below, they would ere long arrive in a region, where they would be glad to wrap their limbs in these seeming incumbrances; and so it proved; for, at the distance of a mile from the top of the mountain, we were involved in winter. The dark volumes of vapor which, from the hotel whence we departed, appeared in detached masses, only as a light drapery, gracefully rolling up the breast and over the hoary peak of Mount Washington, were now congealed, and involved us in a white driving cloud that froze on our apparel, and tufted the rocks with splendid crystallizations of ice. Here our guide, having issued the welcome command to dine, opened at once the treasures of his pack, that we might obtain vigor for the remainder of our toil, the severest part of which was still before us.

Our refreshments were indeed most acceptable and salutary; but our hands were so benumbed with the cold, that we could scarcely convey the food to our mouths.

From our hasty repast, we started again, as if pursuing or pursued, and struggled onward over immense piles of ruins frosted with the congealed vapor, and thus rendered treacherous to the feet, which were constantly in danger of sliding into the innumerable chasms and holes that yawned around our path. Our toil grew more and more severe,—not a vestige of human footsteps remained, and we were guided only by piles of stones erected as landmarks for the adventurer. The last stunted evergreens ceased to appear, the wind blew a frozen gale, involving us in white palpable clouds, which were rather masses of flying ice than ordinary snow; they invested every object, and hung in magnificent tufts of long, slender, and perfectly white crystals, from every rock and over every chasm.

Still, an occasional outburst of the sun threw a glorious flood of golden light over the enormous peaks that were grouped

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as an encouragement to those who have less vigor, that I have known a gentleman of a very feeble frame and still feebler health, and with lungs that had suffered alarming attacks of disease, ascend Mount Ascutney, about three thousand feet high, with safety and without excessive fatigue; but it was done very slowly and with frequent pauses and resting to recover. I was of the party, in 1822, and was astonished to see how little he suffered. If these remarks are of any value to the young adventurer, who may thus be saved from injury, their introduction on this occasion will be excused. I am quite sure, from considerable observation among mountains and mines, that such suggestions are too little regarded.

thickly around us, and disclosed the immense bosoms of the valleys and the green forests that opened among this wild ocean of mountains; the trees on their sides, appeared minute and delicate as geraniums, while the deep and wide chasms produced by vast slides, presented horrid features of devastation, attesting the ravages of alpine floods, bearing down before them forest, soil, and rocks, with every movable thing, and thus gashing the solid frame work of the everlasting hills with the deep wounds of the olden and the modern time.

Quite at the feet of the mountains, and along the opening vales and plains, ran in full view, silver streams, among cultivated fields, gracefully bordering the works of man—his houses, farms, and villages.

Again, the clouds of flying ice, resembling tufts of cotton, closed thickly around, and hung an impenetrable veil between us and the world below; a wintry tempest now raged around, and with great difficulty we mounted the last rocks, and saw that there was nothing higher than ourselves. Here the wind blew a furious gale, and the strongest man among us could not keep his standing without holding fast by the rocks, while those who neglected this precaution were instantly prostrated by the storm, which, as if in exultation, roared and howled with a truly savage grandeur, over this wild alpine solitude. The cold was so severe and the pelting of the storm so violent, that a few minutes at a time was all that we could give to the mountain peak. We were glad to step under a covert, where the rocks afforded a partial shelter from the tempest, and here we finished our little remaining store of refreshments.

For science there was little to survey. The piles we trod on were the ruins of the stupendous granite mountains, elevated in ancient time, lashed by the storms, cracked by frost, and mutilated for untold ages by the sure, although slow agencies of nature. The very peak of the mountain is mica slate supported by granite. There could be no doubt, that the immense masses of loose rocks, of every size, which we saw around us, were once united in a connected summit, and that these ruins are only evidence of the mighty work of demolition, which is always going on with a real although imperceptible progress. As to organic remains, it were vain to look for them in this primitive region, and almost equally vain is it to expect to find any living animal in these wild and barren solitudes. It is, however, a satisfaction to have trod on the highest peak of New England, the most elevated of the United States, and of North America, until we reach the Rocky Mountains and the table land of Mexico. The arduous circumstances of our ascent and the absence of instruments prevented any accurate observations; but the height of this peak is generally stated to be between six thousand and seven thousand feet, probably six thousand five hundred above the level of the sea.

It nearly penetrates the region of perpetual cold—therefore winter relaxes his dominion but for a very short period, a few weeks at most, in the hottest season of the world below, and summer never smiles upon the summit of Mount Washington. On the succeeding day as we travelled, we saw this mountain quite white, from its peak a long way down and around, on every side that was within our view.

The descent was of course more rapid than the ascent; it was much less fatiguing to the lungs, but very trying to the limbs, especially to the larger muscles and to the patella, which seemed as if it would part with the strain. Great caution was requisite also, to avoid falling into the innumerable holes among the rocks, and to prevent slipping from their smooth and glazed surfaces. Arrived once more at the camp where the horses, become restless with hunger and now eager for their stables, remained fast bound to the trees—we quickly mounted, and twilight beginning to set in, we hastened through the pilgrimage of the muddy forest, till having arrived in the open ground, all dashed forward with cavalry speed, and the poorest rider on the hardest horse fares ill in a race, which he is neither able nor much disposed to resist or avoid. All hurry onward, as if from the route of disastrous battle, and glad is the adventurer to find himself once more safe in the truly comfortable hotel, where he is regaled not only with all necessary refreshments, but with wonderfully fine echoes produced from the neighboring mountains by a long shrill horn, blown at the door of the hotel, after evening has closed in, and by the discharge of artillery, whose explosion is returned in deep and solemn reverberations from the winding hills. The ascent of Mount Washington is certainly worth the toil and trouble, although probably few appreciate it justly, before they have made the trial.

The pedestrian ascent occupied two and a half hours, and the entire journey about ten hours, of strenuous and constant exertion.

## Art. V.—*On the Tides;* by David Tomlinson.

Schenectady, Aug. 1st, 1837.

TO PROF. SILLIMAN.

*Dear Sir,*—I have read with much pleasure, several ingenious strictures on storms of wind, by W. C. Redfield, as published in former numbers of your useful Journal of Science.

In your No. II, for July, 1837, in his remarks on this supposed connection of the Gulf stream, "with opposite currents on the coast of the United States," he says, "the Gulf stream, in its course from Florida to the banks of Newfoundland, is for the most part *imbedded or stratified* upon a current which is setting in the opposite direction in its progress from the polar region—that their opposite courses on the coast while in contact with each other, are no more surprising or inexplicable than the case of two opposite currents of the atmosphere, and the latter are often known to maintain opposite courses for a long period, and at high velocities, while thus superimposed one upon the other."

The different currents of the atmosphere are often rendered visible, by the courses of fleecy clouds; but, that contrary and rapid currents, of so dense a fluid as water, should be "imbedded," one in the other, appears to contradict the laws of friction, impulse, and motion.

I am aware it has been said, that, at the straits of Gibraltar, where from the Atlantic ocean a strong and regular current always flows into the Mediterranean sea, this current is caused or balanced by an under or contra one at the bottom, flowing equally swift outward into the ocean; and that this has been proved to be true by the wreck of a vessel known to have been lost in the Mediterranean sea, having been seen in the Atlantic ocean; but a single instance is not conclusive; for, if it were the same wreck, a strong east wind might have driven it out.

I know the danger of suggesting any thing in opposition to established opinions of great and learned men; for instance, in opposition to the opinion, that the moon is the cause of the flowing and ebbing of the tides. That the attraction of the moon regulates the times of the tides caused by the Gulf stream, after their becoming into existence and being set in motion, is evident; but that the flowing and ebbing is wholly caused by the moon, appears to be contradicted by strong evidence. That the Gulf stream gives the peculiar character to the tides on the coast of North America, appears certain. Where it leaves the Gulf of Mexico, the rise and fall of the tides is said to be two or three feet only. The tides increase with that current to the east, till it rises more than twenty-five feet in Nova Scotia and Newfoundland; where that wave is wafted across the ocean to the Irish and British channels, and the Bay of Biscay, of about a similar height. But at St. Ubes it rises only one to two feet, and in the Mediterranean sea there is no rise and fall of tides.

If the moon were the sole cause of the rise of tides, why is it not more evident in the south Atlantic, West Indies, and coast of South America, where her influence ought to be the greatest, in the greatest expanse of ocean? And yet the tides there are so so small they are scarcely noticed.

It is said that the Gulf stream is caused by the effect of the trade wind on the Caribbean sea, by pressing the water westward, and causes the outlet at the Gulf of Mexico. That may produce some effect; but can it be the sole cause of the Gulf stream? Although that stream may be swayed from its course (like a cable in a stream) both north and south, by long and violent winds, (as has been seen,) yet it resumes its wonted place and preserves its regular course so exactly, that in approaching it in fair and moderate weather in day light, by ascending the shrouds of a vessel, it may be seen at a great distance, and when passing it, the edge of the stream may be discerned as plainly as land from water. It appears as blue as indigo, while the adjoining water is of the usual green hue. The division is so exact, that it may be noticed as plainly as the crack between the planks in a house floor; and yet, if you dip a bucket of water from the stream, it is of similar clear and white appearance as the common ocean or other water, but warmer. Why does the ocean always run swiftly into the Mediterranean sea, as do the immense Danube, Nile, and other large rivers? No doubt to keep up the subterranean stream which passes out of the Bay of Mexico, called the Gulf stream. This sustains the usual circulation and its warm temperature and throws off an immense evaporation, as it runs towards the colder region, where it is condensed to furnish materials for watering the Atlantic coasts by frequent rains, without which, they would be rare, and the land parched by drought.

McKenzie found a tide of about fifteen feet, when he reached the ocean, on his travels to the N. W. coast of America, near Behrings' strait. It is said there is a great tide at Calcutta; yet, if we may believe the navigators, it is small at the Sandwich Islands, rising only one or two feet, the highest flood always at meridian, and being thus totally disobedient to the rising and setting of the moon in that immense expanse of ocean, where her influence ought to be greatest.

I here quote from the American Quarterly Review, No. xxxix, for September, 1836, p. 10. Art. I. Report made to the Senate of the United States, on the subject of an exploring expedition to the Pacific ocean and the South seas, by Mr. Southard, chairman of the committee, March 21st, 1836. "We shall detain the reader but a moment longer on this branch of our subject, to mention a singular fact in relation to the tides in the Pacific ocean, and we do this, in order to draw the attention both of practical navigators and philosophical observers."

"*It is stated* by the intelligent Mr. Ellis, the missionary who resided several years in Tahiti (Otaheite) and the Sandwich Islands, that the rising and falling of the tides, (in the South sea islands,) if influenced at all by the moon, appears to be only so in a very small degree. The height, says he, to which the tide rises, varies but a few inches during the whole year; and at no time is it elevated more than a foot or a foot and a half. The sea, however, often rises to an unusual height; but this appears to be the effect of a strong wind blowing for some time from one quarter, or the heavy swells of the sea, which flow from different directions and prevail equally during the time of high and low water. During the year, whatever be the age or situation of the moon, the water is lowest at six in the morning and the same hour in the evening, and highest at noon and midnight. This is so well established, that the time of night is marked by the ebbing and flowing of the tide; and in all the islands the time of high water and for midnight is the same. The same thing is stated by Messrs. Tyerman and Bennet, in their journal of voyages and travels: it is generally known, they observe, but may be repeated here, in connection with the aforementioned periodical but irregular inundations of the sea, that the tides *throughout the Pacific ocean do not appear to obey the influence of the moon in the slightest degree.* It is always high water about twelve, and low about six o'clock, day and night. The fact has also been noticed by a few British navigators. Capt. Beechy, after describing the harbor of Papiete and of some other places on the north side of Otaheite, says, it is generally high water at half an hour *after* noon every day, and low water at six in the morning; at the same time he observes, in language which might mislead the reader if not understood with some qualifications, that the tides in all these harbors (of Otaheite) are *very irregular.* These irregularities are, doubtless, what Messrs. Tyerman and Bennet call "irregular inundations" of the sea, which according to Mr. Ellis, are occasioned by the strong winds blowing for some time from one quarter, or the heavy swells of the sea coming from various directions. The fact is also confirmed by an intelligent correspondent, Mr. John Ball, of Troy, N. Y.,* who states, that during his three weeks' stay at Tahiti, the tide was observed to rise about one foot, and always highest at twelve o'clock, noon and midnight; and he adds, I was informed that this is always the case. Another writer, whose remarks are published in the Journal, (from that of the Franklin Institute,) adds to the testimony on this point the following,—that Prof. Whewell states, that Lieut. Malden, who accompanied Lord Byron on his voyage to the Sandwich Islands in the British ship Blonde, in 1824–25, gives a similar account of the tides at Owyhee. But the language of Lieut. Malden is, that the tide was observed to rise about four feet, and to be high water at sunset, and low water at day light, being influenced by the sea and land breezes."

## ART. VI.—*Equalization of Temperature and supply of air in rooms warmed by furnaces beneath; in a letter to the editor, from* JAMES BOLTON, A. M., M. D., dated Fredericksburgh, Dec. 25, 1837.

*Dear Sir,*—HAVING amused many of my leisure hours with investigations into the best modes of applying heat to the warming of houses, I send you the following as the most important results which I obtained. Our own dwelling was warmed by an ordinary hot air furnace, and to it I found the following objections. The air was admitted into the air chamber of the furnace from the basement rooms and hall where it was placed, and this air ascended into the parlors loaded with coal dust and other impurities. This evil was entirely corrected by obtaining all the air for the supply of the air chamber from without the house. A large eight inch pipe was led from the bottom of this chamber through one of the walls of the house to the open air. This, besides obviating the difficulty above stated, ventilated our rooms with a constant supply of fresh air. The next objection was, that persons sitting in our rooms complained of cold feet, while in every other respect they felt comfortable. On examining the temperature of the air in the room at different heights, I found a variation of a degree for every foot. That is, at the height of six feet from the floor the thermometer stood six degrees higher than at the floor itself. This, then, was a very serious objection, and I set about immediately endeavoring to remove it. On reflection, it occurred to me, that as our rooms were very tightly closed, having double sashes to our windows, the flues of the chimneys closely stopped, and the doors (made to fit tightly) generally closed, that there was no way of escape for the air already in the room, when the furnace was set in operation, so that it could not readily receive the addition of heated air, and none for the exit of the air after it had given out to the room its share of caloric received from the furnace. This cold air settled to the floor and there lay almost stagnant. Here, then, was the root of the difficulty. To remove it I adopted the following expedient, which proved entirely effectual. I led a pipe from the floor of each room to the bottom of the air chamber, and cut off all other supplies of air. The process of heating the air, then, was as follows. That already in the chamber was heated and ascended to the rooms above; to supply its place the cold air of the rooms descended by the pipes which I had introduced and was in its turn heated and ascended; thus keeping up a constant circulation of air in the rooms. I afterwards introduced a two inch pipe to supply fresh air to the chamber from without the house. This pipe had a valve, so that I could regulate the amount of air supplied by it. The effects of this improvement were, that there was a difference in temperature of only a degree and a half in six feet instead of six degrees as formerly, and we were no longer troubled with cold feet while sitting in these rooms.

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* See this Journal, Vol. xxviii, p. 8.

After testing the utility of these improvements for about five years, being desirous that all using furnaces might avail themselves of them, I have sent this communication for insertion in your interesting record of the daily improvements going on in the arts and sciences.

## ART. VII.—*Description of an Air Pump of a very simple construction, which acts both as an exhauster and condenser; by* JOHN JOHNSTON, A. M., Professor of Natural Science in the Wesleyan University, Middletown.

THE last No. of this Journal* contains a description of a very ingenious air pump invented by Dr. Hare, Professor of Chemistry in the University of Pennsylvania, which is capable of performing on a much larger scale precisely the same operations as the one I am about to describe, but in quite a different manner. The next day after I had contracted with Messrs. Brown & Francis, in New York, for this air pump, which is now in possession of the Wesleyan University, I had the pleasure of viewing Dr. Hare's in his laboratory in Philadelphia.

This pump, as will be seen by the figure, has two barrels, in which the pistons are worked precisely as in those in common use, and, in general, it is constructed in a similar manner. The pistons, however, are solid, and at the base of each barrel are two valves, one opening upward and the other downward. In the center of the firm piece of mahogany, which forms the base of the instrument, are two brass tubes, which are seen in the figure at A and B, by the removal of the plate of brass D. Of these tubes, A communicates with the valves—one in each barrel—that opens upward, and B with the valves that open downward. Now when either of the pistons descends, the air in the barrel below it will of course pass out through the downward opening valve and tube B connected with it; and when it is again raised, the air will pass in through the tube A and the upward opening valve. At the center of the disc F, is an aperture, as in common air pumps, into which a tube may be screwed, and directly beneath it is another aperture communicating with the tube G; and the part EC is constructed in such a manner, that when E is upward, a passage is opened between the aperture F and tube A, and also between the tubes B and G. If the pump be now worked, it is evident the air will pass in at F and out at G, that is, it exhausts at F and condenses at G. If, however, we give EC a quarter of a revolution, and bring C upward, the passages from A to F, and from B to G, are closed, and others opened from B to F, and from A to G; and by working the pump the air will now be made to pass in at G, and out at F, or in the *reverse* direction from that just described. This pump, therefore, like the one described by Dr. Hare, when worked is constantly exhausting and condensing.

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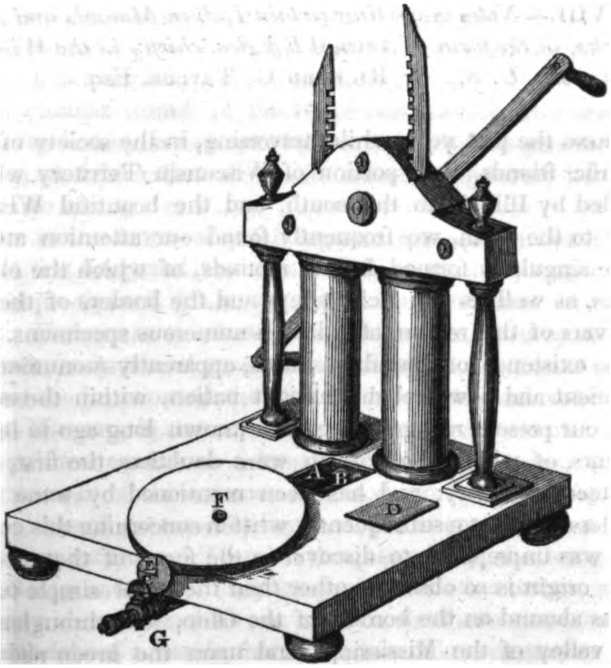
* Vol. xxxiii, page 237.



The uses to which this air pump may be applied, obviously include all those of a common air pump and condenser; and also enables the operator to transfer any gas that will not corrode the metals from one vessel to another, (as does that of Dr. Hare.) To do this, it is only necessary to attach tubes at F and G leading to the different gasometers or other vessels between which the transfer is to be made; and by means of the part EC the gas be made to pass in either direction at pleasure.

I ought to remark before closing, that previous to my application to Messrs. Brown & Francis, they had manufactured several air pumps of this description, with the exception of the tube G, which was added at my suggestion; and which adapts it in a peculiar manner for use in a chemical laboratory.

Messrs. Brown & Francis also manufacture a much smaller air pump, with a single barrel of the same construction.

## ART. VIII.—*Notes respecting certain Indian Mounds and Earthworks, in the form of Animal Effigies, chiefly in the Wisconsin Territory, U. S.;* by RICHARD C. TAYLOR, Esq.

DURING the past year, whilst traversing, in the society of some scientific friends, that portion of Wisconsin Territory which is bounded by Illinois to the south, and the beautiful Wisconsin River to the north, we frequently found our attention attracted by the singularly formed Indian mounds, of which the elevated prairies, as well as the rich valleys and the borders of the lakes and rivers of this region, afford such numerous specimens.

The existence of abundant traces, apparently monumental, of an ancient and now probably extinct nation, within the country under our present recognizance, was known long ago to its early explorers, of which the French were doubtless the first, in the seventeenth century, and has been mentioned by some of the travellers who have subsequently written concerning this country. But I was unprepared to discover in the forms of these remains, whose origin is so obscure, other than the usual simple tumuli; such as abound on the borders of the Ohio, and throughout the great valley of the Mississippi, and upon the green plains and rich bottoms of the Missouri; which tumuli do closely resemble those which are so profusely scattered over the plains of Europe, and are especially abundant on the chalky downs of England.

Rumors of the remains of an ancient city, discovered within the past year, in the eastern part of this territory, wherein the ground plans of supposed buildings and fortifications may still be traced, had been lately circulating in the United States, and contributed to lead our attention towards those singular memorials which daily presented themselves on the route through this interesting region. Respecting the so called city of Aztalan,* I was prevented, unfortunately, when within a day's journey, from reaching its site; and regret my inability to speak from personal knowledge on this subject. Information of a more detailed and scientific character than we now possess is much needed.

As relates to a great number of other positions, it was discovered that the configurations of the earthworks, or mounds as they are usually termed, which at first sight appeared decidedly to resemble the sites, or ground plan, and foundation lines of former buildings, were really designed as rude representations and outlines of certain animals, and even of the human figure; in addition to those tumuli which had been constructed in the usual circular, quadrangular, and oblong shapes.

The circular tumuli of the Wisconsin prairies, are commonly about fifty feet in diameter, and are not elevated, in general, more than ten or fifteen feet above the surrounding level; but often not half so much.

Those in the forms of parallelograms are seldom less than a hundred feet long, and are occasionally seen much longer, as in the example figured, [pl. II. fig. 3,] which is six hundred feet in length. Perhaps in this instance it was thrown up as a defensive earthwork, as its situation seems to indicate.

Above the junction of the Des Moines River with the Mississippi, in Missouri, in the region locally known as "Black Hawk's Country," we examined a long range of the circular tumuli. These were all of the common size, and some of them contained recent graves of deceased Indians, as was afterwards observed in many other localities. Thus, in the present day, the burial place of the Sauks and Fox, the Winnebago, and other tribes, is very commonly chosen upon the site of the more ancient monuments; the memorials of a people that existed in unknown times.

It is scarcely necessary here to include within our notice those mounds of much larger dimensions, existing on the borders of the Ohio and Mississippi, to the south and east. On the former river one mound is seventy feet high, and thirty or forty rods in circumference. Even within the limits of the rapidly rising city of St. Louis, are some of great magnitude. On the American bottom, at the village of Cahokia, (Illinois,) it is stated by a contributor to a Western periodical, that more than two hundred mounds are visible from one spot; the largest being 2400 feet in circumference, and 90 feet in height; in figure approaching to a parallelogram. In the Cherokee country an earthwork has been described, as 75 feet high and 1114 feet round.

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* The Mexicans have a tradition that they originally came from the north, from a country called Aztalan.

The earthworks which have been constructed in the shapes of animals, abound in the Iowa district of Wisconsin. They occur, mixed with the other varieties, in great numbers, around the high lands which skirt the "Four Lakes," forming a species of *alto relievo*, of gigantic proportions. This district appears to have been originally much resorted to by the early tribes, whose relics we here behold, mixed with those of the modern Winnebagos. At one spot alone, probably, at least one hundred tumuli may be counted. The Indian path, along which we passed, has, for near half a mile in length, a series of these, mixed with circular mounds, in tiers several deep, on both sides; forming a cemetery in magnitude of itself sufficient, one would imagine, for the chiefs and warriors, and their descendants, of a whole tribe, if such was the original design of these earthworks. On the summits of some might be seen the recent graves, protected by pallisados, of the last Indian possessors of the soil.

The site of the singular group of mounds exhibited in our figure, [pl. I. fig. 1,] is about eighteen miles west of the Four Lakes, and seven miles east of the two remarkable natural hills called the Blue mounds. The area comprehended in the drawing is about two thousand three hundred feet in length. The figures are traced from survey, and their dimensions and the intermediate spaces, were ascertained by admeasurements. In this group there are seen the effigies of at least six quadrupeds; six mounds in parallelograms; one circular tumulus; one human figure, and one circle or ring which may have been formed by the Indians in their dances, whether peaceful or warlike, or may have been occupied for some such purpose, in by-gone times, as the torturing and destroying their prisoners. The great Indian trail, or war-path, which leads from Lake Michigan, near Milwaukie, to the Mississippi above Prairie du Chien, passes along the edge of this chain of earthworks, and is now for many miles adopted as the route of the military road to the latter fort. We pursued this route for a great distance along the dividing ridge between the northern and southern waters; and we continually saw memorials of the character above described, along its borders.

What animals are represented by these rude monuments of earth, now covered with the rank prairie grass, is not made altogether apparent by their designers. If of the horse, the design is somewhat doubtful. We were rather inclined, however imperfect the representation, to attribute the intention of the constructors to be that of exhibiting the figure of the Buffalo; an animal which had here the finest pasturage, and an almost boundless range, within one of the most ample hunting grounds, and were exceedingly numerous at the time of the first exploration of the country by the French. It is nevertheless to be admitted, that the hump, a remarkable characteristic of the Buffalo, which it would seem unlikely to have been omitted in the representations of that animal, is never seen in these figures, which are distributed over the surface of so many hundred square miles of this country.

The respective dimensions of these animal effigies in our ground plan, are 90, 100, 102, 103, 120, and 126 feet in length; all of them apparently represent the same description of animal. Figures having precisely the same proportions in their outlines, may be seen at very short intervals throughout the Territory of Wisconsin, being generally from 90 to 120 feet, and extending to 150 feet long. This form, although the most prevalent, is by no means the only one, as we shall proceed to show.

In the midst of this group, represented by our sketch, and forming a very important portion of it, we have now to notice the representation of a human figure, lying in an east and west direction; the head towards the west, and the arms and legs extended. Its length is one hundred and twenty five feet, and it is one hundred and forty feet from the extremity of one arm to that of the other. The body or trunk is thirty feet in breadth, the head twenty-five feet, and its elevation above the general surface of the prairie, is about six feet. Its configuration is so distinct, that there can be no possibility of a mistake in assigning it to the human figure.

There is nothing remarkable about the oblong mounds. The circular tumulus in the centre is the highest, and overlooks the whole group. Whether all or any of these earthworks contain bones, we had no opportunity of determining. They probably all do.

The site of this interesting series is an elevated open prairie, on the dividing ridge between the waters of the Wisconsin and Rock rivers. These monuments are covered with the same green carpet of prairie grass, intermixed with bright and brilliant flowers, as the prairie itself. There is an intervening space near the centre of the group, now overgrown with bushes, which probably conceal some unnoticed mounds. The figures marked on these and the other animal outlines in our drawings, indicate their dimensions in feet.

We twice visited these singular specimens of Indian antiquity, and consequently can speak with greater confidence as to the general accuracy of the sketch accompanying this article.

Half a mile westward of this remarkable group, and on the same elevated prairie, occurs a solitary mound, about ninety feet in length, representing an animal in all respects like those we have described, but lying with the head towards the southwest. [Pl. II: fig. 2.]

Along the space of twenty miles from this position, extending to the Four Lakes eastward, similar monuments, intermixed with plain tumuli, are seen at almost every mile, in the lowest situations as well as crowning the highest swells of the prairies; and they are still more numerous all around those beautiful but almost unknown lakes. It would be a ceaseless repetition of similar forms were we to figure many of these, but the outlines of a few of the most characteristic are introduced in the plate. Had time and circumstances permitted a more leisurely investigation and survey of some of the groups of this region, there is little doubt but many drawings of a highly interesting character could have been constructed in addition to those which illustrate this communication.

Fig. 3, Pl. II. An effigy ninety feet long, in form resembling the animal outlines previously described, is placed nearly at the foot and at the point of a remarkable, picturesque, perpendicular bluff, of coarse, friable sandstone, fronting a rich meadow, the favorite resort, no doubt, of numerous buffalos in olden times. In front of this bluff, and enclosing the mound or effigy, is a long earthwork in an exact straight line, about two hundred yards in length, having an opening in the centre opposite to the animal. The position of this earthwork indicates its having been designed for the purposes of defence or fortification against an enemy; perhaps as an outwork to the strong hold in the rear, formed by the bluff itself. The great Indian road to which we have already referred, skirts along the outer or southern side of this embankment.

Fig. 4, Pl. II. This sketch is drawn from the admeasurement of a couple of animal-shaped mounds, between which passes the same Indian path, at the distance of six miles west of the Four Lakes. These figures are selected to shew that one, if not both of them, represented a different species of animal to those we have traced in the preceding outlines. In one instance only they were depicted with the appendage of a tail; the others were tailless; and whether in the present case this deviation from the usual configuration resulted from the caprice of the Indian artists, or really depictured some beast more favored by nature than his contemporaries, it is not easy at this period to decide. They are respectively one hundred and twenty and one hundred and two feet long, and perhaps may have been intended to represent foxes.

*Fig. 5.* Beyond the Wisconsin Territory, on the north side of the river of that name, in the region still held by the Winnebagos, are innumerable mounds, both of the circular and most of the other forms we have figured. At one position, however, near the river, and not far from English prairie, a group of six of these appear to represent birds, probably the eagle, or perhaps the crane, which was the ancient badge of the chiefs of a branch of the once powerful tribe of Chippewas.* This sketch was communicated to the writer by the person who took the original admeasurements. The scale of these is about the same as the preceding.

*Pl. I, Fig.* 2 is a tracing from a sketch drawn to a larger scale, of a bird-shaped mound, in the same region; which sketch was furnished me by an intelligent individual, but of course I am unable to vouch for its accuracy. Possibly the figures which elsewhere I had noticed as possessing the general form of the letter T, might on further inspection have been found to approach to the bird form also.

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* Col. McKenney's History of the Indian Nations.

Forms supposed to represent turtles have also been seen in more than one situation, constructed on an equally large scale. Of this class I cannot speak with sufficient certainty from personal observation. We know that there existed the "Turtle Tribe" of Indians, which had that animal for its badge. The "Walking Turtle" family, according to McKenney, was one of the highest distinction in the Winnebago tribe.

To the above notices may be added some memoranda of certain other points where I observed, or have knowledge of the existence of tumuli or mounds in the shape of animals in this western region.

At the great savanna or prairie on the south bank of the Wisconsin river, called English prairie, are earthworks having the circular, the oblong, and the usual animal forms, and also some which bear resemblance to the Roman letter T, as shown in Pl. II. Fig. 1.

Animal effigies occur fifteen miles to the southwest of the last mentioned locality, along the course of an ancient trail, and also of the present military road to Prairie du Chien from Fort Winnebago. Numerous others may be recognized between these and the Mississippi.

In the vicinity of the remarkable hills called the Blue Mounds, they occur abundantly. These hills were, until very lately, a great resort of the Indian inhabitants; as their existing paths, converging hither in singularly straight lines from every point of the compass, amply testify.

In the centre of the territory, at sites which it would be tedious to enumerate, we repeatedly passed by similar mounds, almost invariably contiguous to Indian paths, whose deeply-worn, but narrow tracks, attest their extreme antiquity and long use.

Between the interesting limestone hill, styled Sinsinnawa Mound, and the town of Galena, these animal representations are seldom out of sight, and are accompanied by earthworks of simpler forms. They prevail equally in the low meadow sites, as upon the higher prairie ridges.

Elevated circular tumuli rise from the flats on the margin of the Mississippi, at the old French village or trading station of Prairie du Chien.

All along the borders of the beautiful Wisconsin river, extending from its mouth to the Winnebago Portage, similar monuments are traceable on the high and dry lands. Occasionally they occur in groups and chains, and not solitarily, and are of various fashions. On the shores of Lac de Boeuf and Lac Apucaway, wherever the land is dry and sufficiently elevated, one may observe, even from the water, a vast number of tumuli. Upon the summits of some of these may from time to time be recognized the modern grave of some Winnebago or Menominie chief, strongly protected by pickets. The margins of the Fox river are remarkable for the numerous Indian remains of this description. Colonel Petitval, of the U. S. Topographical department, who was engaged during the last summer in a survey of this river, had the kindness, at my request, to give some attention to these mounds. He describes an immense assemblage of them, at a point on the river, called the Red Bank, extending far into the interior, both north and south, for an undetermined distance. Twelve of the mounds at this place were opened under his direction, among which was an animal mound one hundred and fifty feet long. All of them contained human bones in a very decomposed state.

One of the most extensive and interesting collections of these monumental structures, exists near the eastern shore of Winnebago lake, within the reservation made to the Stockbridge and Brotherton, commonly called the New York Indians. I am indebted to Dr. Lyman Foote, of Fort Winnebago, for information on this and some other localities of Indian monuments.

At a place named Crawfordsville, on the Fox river, a group of ancient mounds has recently been announced in the western papers. These structures are described as being from three to seventeen rods (two hundred and eighty feet) in length; generally about four feet high, and they are stated to resemble "lizards, alligators, and flying dragons." They here all point in the same general direction, but are not precisely parallel. Among them there is one very large mound, which overlooks all the rest.

A writer in the United States Gazette, during a late visit to Wisconsin, observed numerous mounds and large embankments, spread over a space of thirty miles around the site of "the ancient city." Some of them were designed, he states, to resemble "lizards, turtles, buffalos, and even human forms." The present wandering tribes of Indians are "entirely unable to give any account of these remains, or to furnish the slightest tradition respecting the ancient possessors of the soil."

Having disposed of as much of the details in my possession, as appear necessary in relation to the localities of animal shaped earthworks, I have little to add concerning the mounds and Indian antiquities of other parts of this continent. Ample details respecting a great many of them may be found in well known works on these subjects, such as that of Dr. McCulloch,* and the Archæalogia Americana.

From these and other authorities it does appear, that the forms of these mounds elsewhere are materially different to those I have been describing in Wisconsin and to the north of it.

The animal form does not prevail in the Indian monuments within the valley of the Ohio. No allusion is made by Colonel Long, in the narrative to his second expedition, to any but the ordinary circular tumuli, in the relative positions of which the editor observes, "we could discover no order or plan." On the banks of the Miami river, a group of one elliptical and four circular mounds is described, and figured in plate 2, of the narrative.

On the Fox river, of the Illinois, Colonel Long saw many mounds, counting twenty seven at one spot, arranged with a certain degree of regularity, "varying from one to four and a half feet in height, and from fifteen to twenty five feet in length. Their breadth is not proportionate to their length, as it seldom exceeds from six to eight feet;" other mounds are described of an oval form.

The square and pyramidal mounds occur most frequently in the south; and Dr. McCulloch, who is good authority on the subject of Indian antiquities, observes, "that there seems to be a material difference in the construction and position of the mounds in Georgia and Florida, from those of Ohio, Kentucky, &c.†

Tumuli, in the form of truncated pyramids, also occur in the south. Dr. Kain has described a group of six possessing this form in East Tennessee. Their proportions are ten feet in height, by thirty or forty paces in diameter, in the base; the whole group being enclosed by a ditch.

Mounds, having an exact rectangular form, are described by travellers as existing in Tennessee.

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* Researches, Philosophical and Antiquarian, concerning the Aboriginal History of America, by I. H. McCulloch, M. D.

† McCulloch's Researches, p. 503.

Mr. Bringier, describing the Indian mounds in the region of the Mississippi, states, that from Red river to St. Louis, a distance of five hundred miles, and in breadth eighty to two hundred miles, mounds constantly occur, and for the most part are symmetrically arranged, and contain human bones and other traces of man. This writer suggests, that they may be the ruins of ancient dwellings, constructed, on the old Mexican plan, of large bricks, and were covered with earth, which, mouldering down, left mounds in such abundance that the traveller is never out of sight of them. What an immense population, he observes, must have occupied these dwellings, which cover so large a portion of the surface of this region.*

That some of the earthworks in the southern part of this continent are attributable to such an origin, appears to be the opinion of other investigators. Professor Rafinesque, on the authority of M. Rhea, states, that in an ancient walled town near Columbia, in Tennessee, are "the ruins of many houses of various sizes, *from ten to thirty* feet in diameter, all of circular form."

The conical form is the most prevalent in Ohio. Mr. Atwater has described many of these, and Dr. Drake, among others, has given the details of four large elliptical mounds within the limits of the city of Cincinnati.

It will be seen by a glance at our diagrams, that no precise position, with regard to points of the compass, determined the construction of the Wisconsin mounds; and that in one case a single member of a group of animals has been placed at right angles to the rest. The choice, in selecting the sites of these memorials of ancient days, appears to have been influenced mainly by the contiguity to the lakes and principal rivers, and to those great lines of interior communication which from an unknown period traversed this fine country. By this arrangement the greatest publicity was given to the burial places of the distinguished dead; to the simple yet permanent monuments erected to commemorate their fame and rank, and perhaps with the design to perpetuate the honor, and to flatter the vanity of some of the many tribes and branches into which this great Indian family appears, from remote times, to have been subdivided.

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* See this Journal, Vol. III, p. 37.

Learned archæologists have speculated as to what nation, in far distant times, constructed the ordinary tumuli of circular form, so abundant in the great Mississippi valley. They have not yet, I believe, commenced to descant on the origin of those other configurations, the recent examination of which has given rise to the present article. From that highly important contribution to North American early history, the "Antiquitates Americanæ," lately edited by the Royal Society of Northern Antiquaries of Copenhagen, little or no knowledge can be acquired respecting the mounds of North America; and the communication in the same work from the Rhode Island Historical Society, refers, for the most part, merely to the chiseled figures and hieroglyphics on the rocks of Rhode Island.

There are few, if any, authentic sources at hand, from whence to draw information, and it is no doubt quite unsafe to rely upon the accuracy of Indian traditions concerning these mounds, especially as the last occupiers of the soil were but comparatively in recent possession. Successive tribes have occupied, by turns, the region of country where these apparent animal and human effigies abound. The Winnebago Indians, a branch of the great Dahcotah or Sioux family, have held possession of that part of the Wisconsin country which lies immediately south of the Wisconsin river, and east of the Mississippi, only from sixty to eighty years. Previously to this time the district was in the hands of the Sauks and Fox Indians, a branch of the Chippewas, who dug and smelted the lead ore, but were driven out by the Winnebagos. Neither of these tribes now erect permanent monuments of this character, to the memory of their dead. We have seen them, it is true, in numerous places, excavate graves, and deposit the remains of the deceased on the summits of the ancient circular tumuli, which they appear to conceive were constructed for such purposes. Some of these modern burial places are accompanied by rude memorials, denoting the tribe and rank, and sometimes by hieroglyphics, in red paint, even recording the principal achievements of distinguished individuals.

But to a far different race, assuredly, and to a far distant period, must we look when seeking to trace the authors of these singular mounds, and the earthworks of such various forms, which are spread over the North American continent, from Lake Superior to Mexico. The degenerate Menominees, and the slothful

Winnebagos, are retiring before the power and the intelligence of the white man of the old world, as the Sauks and Fox Indians had previously retreated from the Winnebagos, and at a still earlier period, the Illinois Indians were nearly exterminated by the Sauks and Foxes.* But who were they who have left almost imperishable memorials on the soil, attesting the superiority of their race? Nation and tribe and family succeed each other, and for a while occupy the land. They vanish in succession, and leave few or no traces. Yet of this unknown people, thousands and tens of thousands of monuments remain, which will scarcely be obliterated so long as the earth retains its present form.

The result of a recent examination, by a friend of the writer, of the interior of many of the Fox river mounds, shews satisfactorily that the animal shaped earthworks contain human bones equally with the round tumuli. These bones were found in a very brittle and decomposed state, having roots and fibres growing through them, and were distributed, commonly, through every part of the mounds. These researches also threw some light on the mode adopted in the construction of these monuments; for it became evident that the bones or bodies of the deceased were originally laid upon the surface of the ground, and the earth was then heaped upon them. No appearances occur of graves being dug beneath the surface, in the first instance.† Upon the summits of many of the original tumuli it is evident that the remains of other deceased persons have been subsequently placed; and a new heaping up of soil thereon contributed to augment its former height. Finally, the wandering Menominee or Winnebago, the last Indian occupant of the prairie, excavates a grave upon the summit, places the body therein, in a sitting or reclining position, and strongly defends it with pickets.

That the more ancient form of burial upon the surface, and of accumulating the soil over the remains of the dead, was not universal among the Indian tribes of North America, appears from the examination of M. Rhea‡ of some antiquities in Tennessee, where, within the ruins of an ancient town or village, fortified with walls, "graves are found in abundance, from one to three feet in depth, containing human bones. The bodies seem generally to have been buried in a sitting posture, with flat stones placed around and over them." I observed a grave or sepulchre of this kind on the summit of the natural hill, of limestone, called Sinsinnawa mound, a few miles north of Galena.

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* McKenney's History of the Indian Tribes.

† One of the animal monuments lately opened by Col. Petitval near the Red Bank, in the vicinity of Fox river, was one hundred and fifty feet long. The excavation was carried along the entire lĕngth, that is, from one extremity to the other, and bones were found abundantly. The number of individuals buried in some of these earthworks must have been very great. Perhaps they each formed the cemetery of a family in those cases.

‡ Made public by Prof. Rafinesque in 1832.

Whilst endeavoring to ascertain the origin of the animal forms, adopted in the Wisconsin territory for monumental purposes, the writer became early aware of the embarrassments attendant on all researches in Indian archæology. It has been suggested, that they might be designed merely to record the achievements of certain chiefs in hunting. That they were sepulchral, and enclosed the remains of human beings, has been proved by the recent examination of many earthworks which have the peculiar forms noticed in the preceding pages.

Concerning these ancient memorials of a by-gone people, viewing them as commemorative of the dead, it has occurred to me that they may have served in some way to designate the respective tribes or branches to which the deceased, in whose honor the structures were reared, belonged. Even at the present day it is an undisputed fact, I believe, that certain, perhaps most, Indian families and even tribes or branches, are distinguished from each other by badges indicating particular animals, or objects; or by devices symbolical of some memorable national event or peculiarity. In the same mode, and for the same purposes, many individuals also, among the more remarkable of their warriors, assumed similar devices; commemorative of personal prowess, of success in the chase or in war; and were further distinguished among their friends and adherents, by titles equally characteristic. Thus have we seen, even within the space of a few months from the time of writing this article, the survivors of an Indian chief recording at the head of his grave, by some rude hieroglyphics, the tribe and attributes of the deceased. And this is Indian heraldry: as useful, as commemorative, as inspiriting to the red warrior and his race, as that when in the days of the crusades, the banner and the pennon, the device and the motto, the crest, the shield and the war cry, exercised their potent influence on European chivalry.

In all times have nations adopted and men arranged themselves under badges and symbols, to which custom and long cherished associations endeared them. Yet were they of no higher import than those of the North American Indian. In the earliest periods men rallied around the sacred person of the standard bearer, with equal self-devotion, and perished in its defence with as much heroism, as after generations have perilled life to guard the consecrated banner, or in our day have died to maintain the glory of a national flag. So far back, even, as the time of Moses, standards were employed to distinguish the different tribes of the children of Israel. There was an assigned place to each banner in the order of the march of the entire host; and all men were directed "to pitch their tents by their own standards, every one after their families, according to the houses of their fathers."

From that time to the present, in nearly all stages of society, may be traced the existence of symbols which were adopted for purposes of a like kind; certain natural objects being commonly selected to designate particular races, nations, or tribes. Among many of such nations, these badges were emblazoned on their military standards, and depicted on their commercial flags; they were sculptured upon their monuments, portrayed upon their escutcheons, incorporated with their architecture, inscribed upon their seals, and impressed upon their coinage. We are informed that the kings of the Medes bore golden eagles upon their shields; that the Greeks, the Trojans, and other warlike nations, had devices painted or sculptured upon their shields and helmets;* and that the ancient Germans bore standards before them in battle.†

The Roman legions planted the imperial standard over a large portion of the then known world. By turns, the shores of Albion have been invaded by the Roman eagle, the Danish raven, the white horse of Saxony, and the Norman lion.

And then, when the followers of the cross led on their marshalled thousands to war against the crescent, what hosts of devices, cognizances, achievements, and symbols, were emblazoned on banner, crest, and shield;—devices derived alike from natural and from imaginary objects, and borne in commemoration of noble deeds, and indicating rank, and honor, and high resolve. Under the red cross of St. George, the lily of France, and a multitude of other standards, the leaders of the soldiers of Christendom were individually distinguished by their own proper heraldic bearings.

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* "Mutemus clypeos, Danaumque insignia nobis
Amptemus:—sic fatus, deinde comantem
Androgei galeam, clypeique insigne decorum,
Induitur."

† Egyptians, Persians, Hebrews, Assyrians, and Greeks, all carried ensigns of different figures in their armies. Among the most celebrated standards was the black crowned eagle of Attila, king of the Huns. It was called Astur, and supposed to be the same as the Schongar of the Tartars. We might also mention the renowned Gonfalon and the sacred Oriflamme.

That spirit which the olden time originated, and which was so strikingly displayed by the chivalry of the middle ages, has, it is true, been modified; and as regards individuals, has been almost obliterated under the changed aspect of the civilized world. But with regard, perhaps, to all existing nations, these symbols are yet associated with the spirit of patriotism, with national honor, or with deeply cherished remembrances of ancient grandeur. The crescent of the Ottoman empire still shines in the East; the fleur-de-lis of France, originating at least as early as the fifth century, is still her honored emblem; the lion of England, that for "a thousand years has braved the battle and the breeze," yet remains a cherished symbol; and, although arising in later times, the eagle of America is no less an object of national pride and endearment.

The foregoing remarks arise out of the obvious similarity of method by which, in all times and in all countries, men, whether barbarous or civilized, have found it convenient to distinguish and arrange themselves. If the untutored Indians have adopted, as the badge of their nation, their race, or their kindred, some simple object in nature, so also have the more refined of the old world constantly pursued the same mode; and doubtless, one common motive led the people of Scotland to select the thistle, those of Wales the leek, of Ireland the shamrock, and of England the oak, for their national emblems; with each and all of which many fond recollections are associated. Thus also did the white and red roses of the rival houses of York and Lancaster, designate their leaders and unite their followers; and the same feeling which gave rise to the local badges of the numerous Scottish clans,* may be traced among the North American tribes, and in like manner, suggested the insignia of numberless orders and associations in the civilized world. If the mail-clad knight of old surmounted his helm with appropriate symbols of courage in the field, of devotion to the true faith, or of constancy to his ladye love, so also does the red warrior assume the attributes of fierce-ness, of strength, revenge, or cunning—qualities which rank among the highest in his esteem—in the trophies of the eagle, the bear, the serpent, or the fox. If among the boldest of knights and kings, Europe had her Cœur de Leon, so have the chiefs of our Indians, though far less known to fame, their appellations; such as the Black Warrior, the Grizzly Bear, the Swift Deer, the Watchful Fox, the Rolling Thunder, and the North Wind. And if in the proudest days of romantic chivalry, amidst the gorgeous panoply of the court, the tournament, or the battle field, all eyes might recognize him of the Falcon, the Leopard, or the Bloody Hand, so also in humbler guise, yet with not less pride of heart, have the brave of our aboriginal Indians commonly been distinguished. No heroes of Greece, or Rome, or the Holy Land, were prouder of the badges of victory and the trophies of conquest, than are the natives of our western world. Within their own limited sphere, they appear to have sought distinction and to have earned characteristic titles, by the exercise of those qualities which are most estimated in savage life; and our own ears are familiar, even at the present day, with such titles as the Black Hawk, the Panther, Alligator, and Rattlesnake; the Young Eagle, the Black Wolf, the White Dog.

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* The institution of clans among the North American Indians, appears to have been general. Archæol. Am. Vol. II.

But it was not individuals, merely, by whom such appellations were borne. We have good evidence that many tribes of North America adopted, and even yet retain for their badges, the simple natural objects whose names they also bear; as in the mentioned instances of the Fox, the Turtle, and other tribes. Information on this head may be found in Colonel McKenney's work "On the Indian Tribes of North America." Another writer, familiar with Indian history, states that "all the Indian nations are divided into tribes, after the manner of the Jews."*

The Shawanese nation was originally divided into twelve tribes, or bands, all of which tribes were subdivided, in the usual manner, into families or clans, of the Eagle, the Bear, the Turtle, &c. These animals constitute their "*totems*," among which is the *family* or totem of the Panther, which sprung from the Kickapoo tribe.

The Crane was the badge of a branch of the Chippewa tribe, as was, doubtless, the Fox of another. The authority last quoted, notices that the Winnebagos, like the Algonquin, and other tribes, are divided into bands, each designated by some animal, as the bear, or by the devil, or some bad spirit.* Among the clans or bands of the Mohawks, were those of the Bear, the Wolf, and the Turtle. The Hurons also had a Bear clan. The Natches, who lived on the borders of the Mississippi, had four clans, or classes; the Sioux proper were subdivided into seven bands, and the southern Sioux into eight tribes, each being separately classed by some characteristic name.† Whether the southern Indians were similarly subdivided and distinguished does not appear. From the different structure and form of their monuments, it is not improbable that there always existed a variety of races upon this continent. And if in remote times those races were classified and designated in the mode which we have seen still exists, and long has existed,—that is to say, under the denomination of particular animals,—it is not altogether incompatible with probability, that the earthworks in which their dead were deposited, and which resemble certain animal figures, were in fact designed as representations of those national or family badges, and consequently pointed out the burial place of the members of those particular tribes.

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* Johnston, Indian Agent. Archæologia Americana.

I confess that I am aware of no positive evidence to show, that any existing tribes or branches, thus distinguished by a species of armorial bearings, actually did erect monuments of earth in the shape of the animals whose names they bear. In the absence of a more plausible conjecture, the idea suggested itself, perhaps on very insufficient grounds, that there might be some connection traced between the animal shaped configurations abounding in the west, and some of the tribes who assumed animals for their badges, and classed themselves under their names.

If, as is perhaps the case, the foregoing views are inadequate to establish the heraldic character of some of the monuments of the aborigines, they show at least that to the same common cause may be traced, at every period in the recorded history of man, in all countries, and in every stage of civilization, the adoption of symbols and devices, derived from the simplest objects, yet characterizing nations, orders and classes, and even the individual members of communities.

Philadelphia, Feb. 12th, 1838.

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* McKenney's History of the Indian Tribes.

† Archæologia Americana.

## Art. IX.—*Observations made during an excursion to the White Mountains, in July,* 1837; by Oliver P. Hubbard, M. D., Professor of Chemistry, Mineralogy, and Geology, in Dartmouth College.

TO PROF. SILLIMAN.

*Dear Sir*—In an excursion to the White Mountains, last July, I made such observations in Mineralogy and Geology, as my limited time and other circumstances permitted; hoping to add something to the little already known of this interesting country, and that the facts when known may stimulate others to farther examination, they are communicated for the American Journal. The details are minute, for I have often experienced the unsatisfactory nature of meagre descriptions, and I trust they will not be useless to others who may visit the same points.

My object is to record facts, and I am happy to say they are so numerous, and so decisive that we do not seem to be in the region of theory, when we infer at once the nature of those causes that have produced the sublime and beautiful scenery that adorns the greater part of this state.

### *Trap Dikes in Granite, in Dorchester and Canaan.*

In passing from Plymouth, through Dorchester and Canaan, over the high ground that separates the branches of the Merrimack and Connecticut, boulders of trap were observed one mile east of Dorchester south meeting-house. These are porphyritic, some of a light gray, containing a profusion of large crystals of glassy feldspar, with two perfect cleavages—with a few of iron pyrites; others of a much darker ground, with feldspar and black hornblende in large and beautiful crystals, and also dark crystallized mica. The mica is in smooth nodules, without lustre externally, but presents cleavage surfaces of great brilliancy, half an inch in diameter. It also occurs in crystals penetrating the crystals of feldspar.

Similar boulders occur in some places in great numbers, on both sides of the new road, from Wright's tavern south nine miles, to Daniel Patten's, in Canaan, near N. E. corner of Hart's pond. Between his house and the guide-board there are several trap dikes in granite. No. 1, crosses the road N. by E.—is seven feet wide, and *porphyritic*—resembling, in color and crystals, the *boulders* described above; is uncovered in several places, and its appearance varies; it ramifies occasionally into several smaller dikes and lines, and in one place, of a few feet square, are eight cut-offs, or dislocations, where the small veins terminate abruptly, and commence again forward or laterally, with granite intervening, and vanish in a line or point. The cracks in the granite pass through the dike, and at the same angle, and yet the dike intersects veins in the granite. A hand specimen obtained here, presents a rare intermixture of trap and granite—actually exhibiting five alternations of the two, as if the fingers of one hand were alternately inserted between those of the other, in the same plane.

Fig. 1.

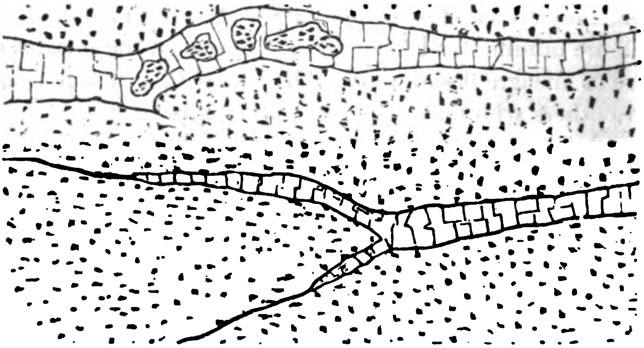
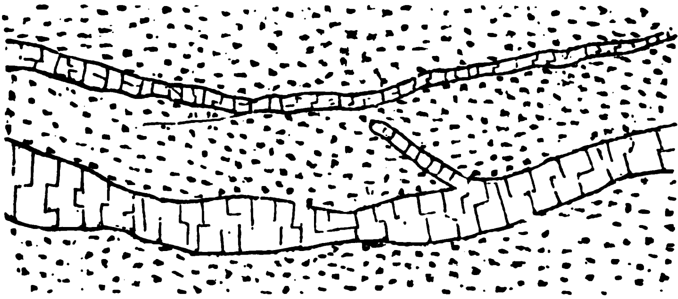


Fig. 2.



Another dike runs nearly parallel with this in the field on the west, which a little farther south, beyond the guide-board, may be observed as No. 2, crossing the E. and W. road in two veins, twenty inches apart—eastern one four inches, and western three inches wide—the former containing imbedded fragments of granite, the latter dividing into two branches, that become mere lines. Fig. 1.

North of this road, in the field, this dike is again uncovered, and appears in two veins fourteen inches apart. The eastern dike is one and a half inches, and the western, four to six inches wide, and they become, as suggested above, at the distance of some twenty rods north, one larger dike. Fig. 2.

The occurrence of the two veins in the field, after one had seemed to terminate, and the change of the vein of greater dimensions from the eastern to the western side, are only some of the phenomena frequently observed in trap dikes, several of which will hereafter be mentioned.

No. 3. A short distance west of No. 2, crosses the road, direction N. E. and S. W., two feet wide, color very dark, not porphyritic.

### *Trap Dike in Wentworth.*

On the road from Orford to Plymouth, one mile west of Wentworth, above the saw-mill on Baker's creek, is a trap dike in granite, on the left hand close to the road, course north, ten feet wide, color dark gray, and even black, very fine grained and compact in some parts, and fracture smooth; in others, amygdaloidal, and contains nodules of chalcedony, and numerous very small round white spots of zeolite, which, from its pearly lustre, foliated structure, and low degree of hardness, is, I think, *stilbite.* Where the surface of the rock is weathered, the stilbite is decomposed, and the cavities are empty.

Darker specimens strike fire with steel, and all give, when breathed upon, an argillaceous odor, most striking in the softer specimens.

Half a mile S. E. of Wentworth, by the roadside, are fragments of red feldspathic granite, lying on granite *in situ*, with a very hard, compact trap, adhering to them, but no dike was observed.

### *Tourmalines and Diluvial Scratches in Rumney.*

A rounded, well defined ridge of granite, terminates abruptly on the south side of the stage road to Plymouth, and is divided from top to bottom, longitudinally, by fissures, into regular masses, several feet in thickness. On the eastern side is a large vein of granite, filled with large black tourmalines in good crystals. The feldspar of the vein phosphoresces very beautifully with a pale sea-green light.

*Diluvial Scratches*, of uncommon distinctness and dimensions, are seen on the west side of this ridge, on an inclined surface, near the road, running east and west.

### *Trap Dikes at the falls in Campton.*

Two miles north of Plymouth, at the falls of the Pemigewasset, are some remarkable dikes. The whole bed of the stream is of solid rock, and the river which makes here a considerable fall, runs in several channels, separated by rugged rocks, each of which must be crossed by a dam to secure the whole power of the stream for manufacturing purposes, which is now in process of execution.

The rock is granitoid, partaking in different parts of the varied character that belongs to the several members of this family, and perhaps may be called *gneiss*, as nearly as any specific name will apply; course N. E.; estimated dip 30° east. This is, however, quite variable, as at dike No. 6, the dip of the strata is near 60°, and the cause is apparent. There is a group of dikes half a mile or more above these falls, which I had no opportunity of examining, but hope the next season to visit them. My description at present is only of that group that occurs at the falls. The number of dikes in this is *seven*, all of which may be examined very conveniently, unless it be No. 7, which, at certain heights of the water, is not quite as accessible as the others. The west bank is intersected by all these, which in some cases may be seen cutting the bed of the stream, the rocky island, and even the opposite bank; and all occur within a distance of a quarter of a mile.*

No. 1. Just above the bridge; dark gray, and nearly black; contains crystals of black hornblende and points of feldspar; crystals and films of iron pyrites in trap and associated rock, in small fissures extending from one to the other; some specimens fire with steel. Course E. and W., and cuts, as in Fig. 3, the island in the stream, and is seen in the eastern bank; intersects veins of quartz.

No. 2. (First below the bridge;) direction E. and W., and in upper part four feet wide; divides a few feet from the water into two branches; the upper one is seen in the island; structure very compact, like feldspar; fracture uneven; color light greenish gray; powder almost a clear white; weathered surface dark brown; fires with steel; translucent on the edges; effervesces abundantly (in powder) with dilute sulphuric, hydrochloric and nitric acids;

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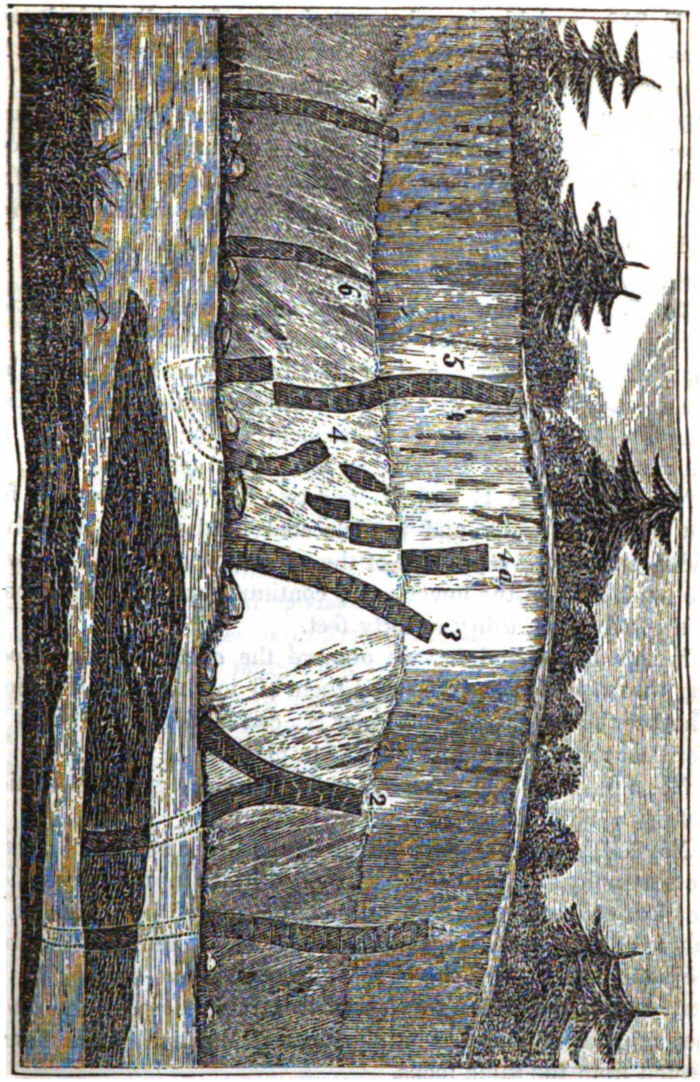
* The accompanying sketch is not intended as a correct topographical *view* of the falls at Campton, but only as showing the *manner* in which the dikes occur. The sketch was made wholly from memory.

Fig. 3.



moist litmus paper held over the solution is reddened by the *carbonic acid* evolved, and the color is discharged in drying; specific gravity 2.61. From the external characters this is a true *clinkstone,* which Gmelin has shown (Edin. New Phil. Journal, vol. vii, p. 68,) consists of mesotype and feldspar.

No. 3. Four feet wide; direction N. W. and S. E.; inclines N. E. 35°; variable in color; specimens of a yellowish brown, clouded with red; others of a handsome light gray; structure compact; fracture flaky, with sharp edges; translucent on the edges; fires readily with steel; minute iron pyrites diffused throughout; effervesces briskly with sulphuric acid, like No. 2.

No. 4. Direction E. and W.; terminates abruptly ten feet from the water in a quartz vein, and with a disconnected lateral shoot, and intersects many quartz veins; curves at and beneath the water, and unites at the distance of five feet with No. 5.

*4a.* Between 3 and 4, consists of three nearly distinct portions arranged in a curve; convex northerly; the terminations all abrupt, except the lower end of the lowest portion. These are, clearly, parts of what was once a continuous dike, and the dislocations evince a disruption subsequent to the injection of the trap; width of 4 and *4a* variable, from six to ten inches.

No. 5. Direction E. and W. and two feet wide; breaks a few feet from the water and is dislocated northerly by its whole width, so that the south side of the upper portion is in a line with the north side of the lower part; continues up the inclined bank to the soil above, thirty or forty feet.

In this and 4, and *4a*, we observe the effects of one dislocating throw, which has displaced them all in the same direction; whether the movement was N. or S., can be determined only by a critical examination of the rocks in place.

No. 5 is exactly like fig. 89, in Lyell's Geology, Am. edition, Vol. ii, p. 237.

No. 6. Terminates eight feet from the water in a blade; intersects numerous quartz veins; six inches wide; nearly perpendicular; but the rocks dip at an estimated angle of 60°: another result coincident with the contortion of 4 and 5, and probably from the same cause. Nos. 4 and 5, we have seen, are united; but all from 4 to 6, inclusive, are so similar in mineralogical characters, they may be regarded as ramifications of the same main fissure, ejected from the same focus.

*Characters.*—Color, black; fracture very uneven; granular; strike fire with steel; contain iron pyrites, and a dark green mineral diffused in small dots, which in vitreous lustre and hardness, very nearly resembles olivine.

No. 7 was not visited for want of time; but as I am informed, is similar to those last described.

### *Porphyritic Granite.*

Proceeding E. from Plymouth, two and a half miles, we find *boulders* of this rock; soon the underlying rock, a decomposing pyritous mica slate crops out, and at three miles, porphyritic granite appears *in situ*, and continues several miles, and along the north shore of Little Squam lake. This rock seems to consist of crystals of white feldspar, some of which are three to four inches long and two inches wide, and held together by quartz and mica, in about the same proportion to the feldspar as the cement of a breccia to the fragments.

*Common granite* is found *in situ* at the top of the hill, after crossing the outlet of the lake; but the boulders of the porphyritic granite are seen, diminishing in number, quite to Centre Harbor; distant ten miles from where they were first observed.

### *Trap Dikes on Red Hill.*

Red hill or mountain, near Centre Harbor, Lake Winnipiseogee, is usually ascended by visitors to enjoy the beautiful scenery of the numerous lakes, with their hundreds of islands, and also of several mountain ranges not very far distant from this peak. The mountain consists of reddish sienitic granite, and its sides are covered with fragments partly decomposed. Near the path leading to the top of the mountain are two dikes.

No. 1 is a few rods north of the second house; seven feet wide; course E. by N.; dip 15° to 20° N.; granite altered at junction, appearing burned and baked; on the lower side the dike is exposed by the removal of the granite, and appears as an inclined wall a few feet high. The color and weight of the trap led some time ago to the supposition, that it was an iron ore, and several tons were quarried under this impression, which, upon better information, were never removed.

No. 2 is one eighth to one quarter of a mile E. of No. 1. Course N. by E.; average width twenty-five feet; dark brown; slight lustre, owing to brown mica diffused through the mass; pyritous, and fires with steel. Near this, but separated eighteen inches from the dike, is a mass of trap several feet in dimensions, and pasted into granite.

### *Trap and Granite Boulders, and Granite Veins.*

East of Centre Harbor, two and a half miles, are numerous fragments of large size, of trap in granite, but no dikes appeared; some of dark blue, others of a reddish brown; a mixture of red feldspar and hornblende, mottled with dark spots; fracture conchoidal, and edges very sharp; strike fire with steel; and others frequently met with in this region, composed of hornblende and feldspar, with an excess of the former, such as Saussure characterizes, judging from description, by the name *cornéene.*

At four miles from C. H. are immense granite boulders, strewed for miles, and the exhibition of granite veins in them is truly remarkable. They are very numerous, usually fine grained, and much whiter than the rock; the regularity and parallelism of their sides is as exact as if drawn by art, seldom over a foot wide, and usually but a few inches, and less: sometimes a rock is cut from side to side by a vein, retaining the same direction and thickness throughout; sometimes by two veins, which are parallel, and again by several, running in every direction, intersecting each other, the older cut by the more recent. In the present state of our knowledge of the formation of veins, and especially of veins of the same composition as that of the rock containing them, whose sides present none of that irregularity common in dikes, an observer might almost hesitate to record facts that may add to the obscurity of the subject, were it not, that valuable general truths can be derived only from an extensive comparison of individual facts.

### *Dikes in Moultonboro'.*

Two trap dikes, in sienitic granite, are found on the right of the road on the top of Rogers' hill, one and a half miles from Moultonboro' corners, towards Tamworth; course W. by N.; parallel, and both contain fragments of granite of considerable size. Fig. 4.

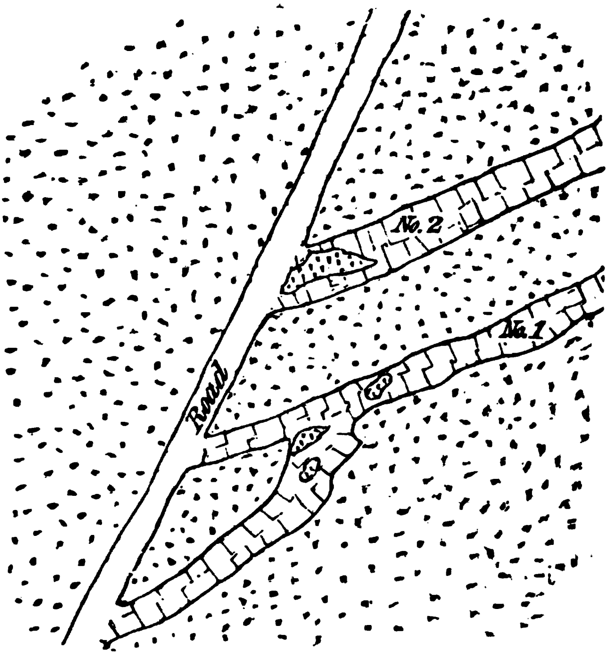
No. 1; one foot wide; sends off a lateral branch which curves southerly; eight inches wide.

No. 2; three feet from the former, is two feet wide, and porphyritic, with crystals of feldspar.

### *Dikes in Tamworth.*

At Fort Jackson, in Tamworth, about four miles west of Things' tavern, on the right of the road at top of a hill, fifty rods from Bear Camp river, is a small trap dike in granite, six inches wide; course E. and W.

Fig. 4.



No. 2, one quarter of a mile east of the former, crosses the bed of Bear Camp river at right angles; course N. by E.; one to two feet wide; inclines down stream at an angle of 40° or 50°, and curves up stream like a bow; is itself crossed in the middle of the stream by a narrow granite fault or vein; on the lower side in several places, the granite, from its greater softness has been removed by the water and the dike, being left prominent, presents the appearance of a dam. This exposes, on the side of the dike, a series of longitudinal light and dark gray stripes, never over two inches wide, arranged horizontally in regular alternations.* The river bed *above*, as well as below this dike, is filled with trap ruins.

### *Dikes in Eaton.*

On the hill, near Mr. Eleazar Snell's, one quarter of a mile east of the village, are two dikes from two to three feet wide and three feet apart; course in general N. E. by E.; one containing a fragment of granite imbedded. Fig. 5. A farmer of the vicinity stated, that there are several other dikes cutting the hill in similar directions, and this statement derives confirmation from the numerous boulders, or fragments of trap, scattered over the fields and laid up in the farm walls.

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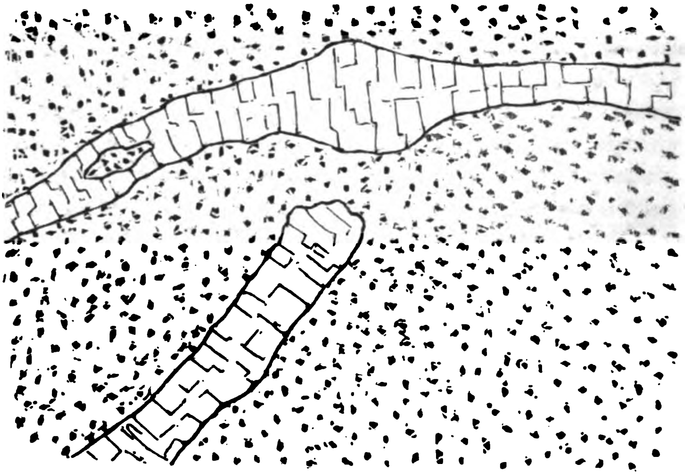
* I owe this notice to the kindness of a friend.

Fig. 5.



### *Blende and Galena.*

Three miles south of Eaton is a mine wrought for lead. The ore is a mixture of yellowish brown blende and galena, which is abundant, and was formerly worked in a shaft fifty feet deep, with a horizontal drift, and as I understand with profit. Operations are suspended at present by some legal impediment, and not through a deficiency of the ore. The specimens, with the two sulphurets intermingled, are beautiful, and will reward the mineralogist for his labor in procuring them.

### *Crystallized Smoky Quartz,*

is found near Pendexter's in Bartlett, occupying large geodes in masses of decomposing granite on the flanks of Kearsage mountain. The crystals are very clear and beautiful, from one to four inches long, and even one and a half to two inches in diameter.

*Arsenical pyrites*, crystallized and massive, occurs in a large vein, in a mountainous tract, four miles north of Bartlett, belonging to Mr. Eastman.

## *The White Mountains.*

It is remarkable, while hundreds of travellers annually visit these mountains, attracted by the grandeur and beauty of the scenery, the salubrity of the air and the delights of the deep retirement from the busy world, that so little has been done to develope the geological character of the region. We may hope the day is not distant, when, in the geological survey of this state, proposed by our Executive, this great desideratum will be accomplished. The labor and expense of exploring the structure of this extensive district with its associated ranges, is altogether beyond the resources of an individual; while, if prosecuted under a liberal legislative provision, the results could not fail to promote largely the welfare of the community and bring to light valuable mineral resources, and advance very much the interests of science.

These mountains will ever be memorable for the dreadful storm of August 28th, 1826, the awful effects of which, even at this period, are every where visible.

The deep channels, worn by the avalanches that then descended from their summits, still form a striking and picturesque feature in the scenery, and the immense heaps of ruins, boulders, and large isolated masses of granite that cover their base, and are strewed in the beds of the streams, testify to the long continued action of degrading forces.

In addition to the graphic accounts of this event in this Journal, Vol. xv, p. 217, some facts came to my knowledge, which I do not recollect to have seen published; and as they were communicated by eye witnesses, and serve to illustrate the power and local character of the storm, they are worthy of record.

At Bartlett, twenty miles below the Notch, the water of the Saco, which runs through it, rose on the morning of the 29th of August, twenty-six feet in one hour, and was filled with earth, like mud, and the sulphureous odor emitted by the attrition of the rocks borne along by the torrent, was almost insupportable. Rev. Mr. Wilcox, in his account, Vol. xv., says, the water of the Amonoosuck, about ten miles from the mountains, was, at day-break on the 29th, raised from a depth of three or four feet to twenty feet, and sixty feet wide, and "as thick with earth as it could be without being changed into mud." A gentleman of this village, Hanover, (which, by the course of the Connecticut, and its branch the Amonoosuck, is not less than eighty or eighty-five miles from the mountains,) observed the same fact here, under the following circumstances.—He had returned from a ride of a few miles up the Connecticut, and along its banks, and noticed the water but slightly risen above its usual summer height, and clear. In about half an hour, he was informed, the river had suddenly assumed a very peculiar aspect, and so different from what he had just seen, that he was incredulous of the truth of the report. On going to the bridge, (half a mile,) he saw no longer a river of pure water, but the channel somewhat fuller than when he last saw it, and a semi-fluid mass, of a light *brick red*, descending in a sluggish current. The water, in fact, was charged with as much earth as it could sustain, and retain its fluidity. Unfortunately, no memorandum was made, so as to recall the exact time of this occurrence, and thus enable us to measure the velocity, or the time taken to reach this place; but it was coincident with the arrival of the news of the storm, and the river continued to flow thus for several days.*

The mountains furrowed by the channels above mentioned, are in a peculiarly favorable condition to be examined, and the records of their history are written in indelible characters. There is the most abundant evidence of the prevalence of igneous agencies in elevating these mountains, and afterwards filling the fissures with intrusive rocks; and from the numerous trap dikes in the sienite and other rocks of the New England coast, and the very remarkable ones in the highlands of Essex county, N. Y., it is not improbable the whole of this primitive region has been convulsed and elevated by the same causes.

### *Decomposing Granite.*

There are many violent causes at work to reduce the large masses of granite to fragments; but as those which are at rest and removed from the action of running water and violent concussions seemed to be undergoing this change, we must look for another and more silent cause. This must be found in frost, moisture, &c., operating especially upon the large proportion of feldspar, the alkali of which is removed, and the mass is thus rapidly disintegrated. The masses exfoliate on their angles and curves, and it is not uncommon to meet with those that seem to be affected by what Dolomieu calls *la maladie du granite*, which, on being struck with a hammer, fall entirely in pieces or grains. The extent of this process may be imagined from the fact, that from Bartlett to the Notch, (nearly thirty miles,) the surface of the ground (as cut by the road ditches) seems entirely made up of decomposed feldspathic granite sometimes to the depth of two feet.

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* The oxide of iron, arising from the decomposition of the rocks for years, seems by this storm to have been swept away, and carried down by the streams; and the inhabitants who live on the bank of the river opposite this village, speak of this ochery appearance of the water as entirely peculiar, having occurred only at this period during the last twenty years.

The gentleman above mentioned has been perfectly acquainted with the river during his whole life, and he assures me nothing of this kind has been known here except on this occasion, for the last *fifty years*.

### *Octahedral Fluor Spar.*

Half a mile above the tavern of the elder Crawford, in the ruins of a slide east of the Saco, this rare mineral is found, which was mentioned twenty eight years ago in Bruce's Mineralogical Journal;* but the difficulty of obtaining specimens is much less than formerly. The spar is found in masses of radiated quartz, easily broken; and occurs in pale green octahedra, from one fourth of an inch to one inch and one fourth in diameter, but is easily fractured in breaking the gangue; it phosphoresces most beautifully, on hot iron, with at first a yellowish light, which becomes finally of a peach blossom color. On ascending the gorge about five hundred feet, (here about ten feet wide,) the quartz is found in place, on the south side of it, in close contact with the granite, which on the other side is removed, forming a vein or dike, (*for it is really one*,) two feet wide, and continuing farther up the mountain. Its structure is drusy, and there is near the middle a double serrated line, formed by the interlocking of quartz crystals. By unknown causes, the fluor has been in many cases partially or entirely removed, and the cavities thus formed are now filled with quartz in plates and crystals. Such a phenomenon in calcareous rocks and veins would be easily explained. The fissure existing, the calcareous matter in solution is deposited on either side, till the drusy surfaces unite in the middle. What greater difficulty in applying the same solution to deposits of siliceous matter in veins? The fluor is not equally disseminated through the vein, but is confined to a portion of one side, three or four inches in thickness, and easily separable from the mass of the vein.

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* Mineralogical notice respecting American fluates of Lime: by the Editor. Bruce's Min. Jour., p. 33, Jan. 1810.

### *Trap Dikes cutting the White Mountains.*

At the foot of the gorge south of the Willey house, we find in abundance fragments of altered slate, slaty trap and basalt, and I am informed by a gentleman who passed over the mountain through this gorge, that in the upper part near the top, it is crossed by *several trap dikes.* Immense ruins lie at the foot of this and the gorge back of the Willey house, which appear as firm as the mountains, and are covered with grass, shrubs and trees, concealing their deformity; but those who have read the description in Vol. xv, of the wild devastation that reigned here, will at once penetrate the deceptive veil which vegetation throws over the whole scene.

### *Dike in the Willey Gorge.*

From the melancholy associations of the last named gorge, my attention was more particularly attracted to it. The lower portion for a considerable distance is obstructed by the rocks and gravel that have rolled down from above. There is a handsome vein on the north side, of crystallized feldspar, of a pale yellowish hue, with crystallized mica in granite. In the bed of the gorge, where it is but thinly covered by debris, beautiful flesh-red feldspar occurs, with many small cavities containing crystals of the same. Ruins of trap found here led me to ascend farther, and on passing the debris, a trap dike appears, forming part of the bed of the channel. Its width is from two to six feet, usually averaging not more than four; course N. E. and S. W., closely embraced by the red feldspathic granite, which is worn down to the same level with the trap. The dike is crossed about five hundred feet from the bottom, by a quartz *vein* or *dike* four feet wide, with parallel and vertical sides, at an angle of about 60°, the parts of which, on the opposite sides of the gorge, would be joined by right lines in the direction of its course, which indicates no disturbance or shifting.

In the bed of the channel may be seen the trap, the quartz and the granite, all so interlaced, that it would seem impossible to decide whether the trap or quartz were the intersected vein; or if they were not both contemporaneously injected, and that too when the granite was not in a consolidated state. Above this, we may observe the dike passing in full width; then sending off branches from the main body, including *apparently* detached portions of granite, or separated by long narrow and broad lines of granite; then becoming confluent into a lesser dike, to be again enlarged, and subdivided into tortuous lines, or stand in curved plates, covering concave surfaces on the side of the gorge, from which the granite has flaked off, or in shoots terminating abruptly, or in evanescent lines, every where enclosing granite, and the granite in turn enclosing trap. This constantly varying appearance of the dike and granite at different elevations, forces the conclusion that the granite was fissured while a tenacious mass, and is still united by filamentous portions running in every direction, and the granite and trap both reticulated, so that if it were possible in a given spot to remove one layer after another, of only a few inches in thickness, each new face would present a varied aspect according to the size and inclination of the portions intersected.

This dike was traced as far as circumstances allowed some fifteen hundred feet high, till the ascent became impeded by a perpendicular front six feet high. The dike was visible above this point till a turn in the gorge, and there can be little doubt that it extends to the top of the mountain, and has completely riven it in two. The gorge is from thirty to fifty feet deep, and at top twenty to thirty feet across, excavated in the rock itself; its sides very steep, vertical, and even overhanging in some places. The trap is generally of a dark or blackish gray, fine grained, crystalline, very compact, hard, fires a little with steel, and contains no foreign minerals; another portion is light gray, and compact; and still another, light gray, seeming like a decomposing earthy sandstone, filled with smooth rounded nodules of the size of a small pea and less, very prominent on a weathered surface, occasionally containing white crystalline matter, but usually earthy throughout, and scratch glass readily. This at the time was saturated with water that runs in the gorge, and the specimens being disintegrated, readily parted, and required careful handling till dried, when they became more coherent. The junction of the dark gray trap and granite is most perfect, as if soldered together; and these specimens presenting a beautiful contrast, may be easily obtained, as a fracture seldom occurs at the line of junction more readily than through the mass.

### *Dike at the Notch.*

On the east side of the Notch, in the face of the cliff, quite elevated above the road, there is a dike four or five feet wide, that may be seen at a considerable distance, crossing several furrows in the cliff, and strongly contrasted in color with the rock.

### *Mount Washington.*

This eminent peak, which is still generally acknowledged to be the highest point of land east of the Rocky Mountains, is one of very great interest to the geologist; and here, possibly, many points in meteorology, affecting materially the history of that branch of science in our country, are to be decided.

Brackett and Weeks gave a rather extended, though general, notice of the White mountain range, in the "Historical and Miscellaneous Collections," Concord, April, 1823, and took levels, in 1820, from the Connecticut river, at Lancaster, to E. A. Crawford's (now Fabyan's) Mountain house, eighteen miles, and found it 1,000 feet higher than the river; then to the top of Mount Washington, and found it 5,850 feet above the river. The facts in this account are interesting, and it would form a very convenient guide-book to any who should wish to examine the range. The only particular to which I wish at present to invite attention, is the nature of the rock crowning the summit of Mount Washington. The visitor, on the west side, has to encounter much less difficulty in ascending the mountain than formerly, as he can ride on horseback seven and a half miles; then commences his journey on foot through the woods, from which he occasionally catches a glimpse of the mountain tops, and when he emerges from the woods, where his vision is unobstructed, the various views are very beautiful; but the object of his pursuit appears still a mile distant. The peak he sees capped with a rocky covering, destitute of vegetation, broken up into huge masses, which, as he passes from rock to rock, seem as disjecta membra in the wildest confusion; but when he has once surmounted the peak, and recovered from the mingled emotions of surprise, pleasure and sublimity which fills his mind, and given his attention to nearer and minuter objects, his satisfaction, if he be a geologist, will hardly be less than when viewing the more distant and imposing scene.

The foundation, or mass of this mountain, as it is seen in the deep gorges cut by the slides in the western side, is granite; and the top has been stated, by those who have and by others who have *not* ascended it, to be granite; and Alpine travellers, who have visited Mont Blanc, have thought they saw in the vast ruins surrounding the summit, the remains of lofty aiguilles, that towered above the present peak; but let the observer stand at the most elevated point, near the rude artificial monument, as in the centre of a decapitated summit, and let him critically examine the rocks in the whole circle about him, and he will soon discover the incorrectness of these opinions. He will find the rocks stratified, layer upon layer, and symmetrically arranged around the center he occupies. The rock is *mica slate,* consisting of coarse mica and fine quartz, occasionally with fine grained veins of the two minerals, with a little feldspar, and some considerable veins of white *quartz.* The uniformity of this surface, in level and appearance, is such, that a passage to the top is marked out by no ravines and eminences, but the path leads directly over the ruins, and the *guide* himself is directed by masses of white quartz, or collections of stones raised at proper distances. Near the top are small *black tourmalines,* and also a small spring of water.

The case is clear. The mountain of granite was raised from the deep, bearing up on its Atlantean shoulders this huge covering of mica slate, that extends a quarter of a mile below the summit, and by disruptive agencies has been fissured in every direction, and reduced to ruins. The granite, instead of rupturing the mica slate, and protruding at the centre of elevation, itself forming the peak, has broken it at some distance from the centre, and we ought to find the long line of disruption of the mica slate, if the rocks remain and are uncovered, very far down the mountain; if not, in the low grounds of the valleys.

The different zones, or belts of vegetation, are distinctly marked on the flanks of the mountain—the lower forests with their varied hues—the upper belt of sombre evergreens—the highest of dwarf trees, stunted shrubs, and long grass and mosses, and terminates at the lower line of the rough weather-worn rocks that form the summit. From this height the several belts may be traced, with the eye, for a great distance each way. The upper limit of vegetation indicates very definitely the comparative elevation of the neighboring peaks, according as it surmounts or falls below their summits; though in the article quoted above, it is asserted, that vegetation uniformly rises higher on the western side than on the eastern of these mountains, and the difference is attributed to the greater elevation of the whole country on the western side.

### *The Franconia Notch,*

seven miles south of the village of Franconia, is approached by a very considerable ascent in the road to the summit level. Some beautiful lakes on the north of this give rise to one branch of the Amonoosuck, and another lake on the south forms one of the sources of the Pemigewasset, while lofty mountains rise on each side of the road, which on the left are almost perpendicular.

The profile on the west, or La Fayette mountain,* is still in high perfection, reminding one of an ancient warrior with his grisly beard and projecting helmet, and a countenance of determination and majesty; the whole presenting, in sharp outline, a face full of expression, like the most labored production of the chisel.

### *The Basin.*

Three miles south of the mountain-house, on the right of the road, is a wonderful excavation in the granite rock, called "the basin." It is perfectly ovoidal, and its diameters (by the eye) twenty five and twenty feet, depth fifteen feet, and filled with water of a pellucid sea-green, and rounded stones in great number lying on the bottom.

A small stream, the outlet of the lake above, pours through "the basin" with great vivacity, entering on the N. E. strikes against the south, and receives a circular motion westward, producing eddies and a complete revolution, and is discharged on the S. W. side. The concave above the water, which is perfect on the N. W. side, and projects over the basin at a height above the water (to the eye) of some fifteen feet, is beautifully rounded and smoothed. It is obvious that the water once flowed so as to strike the highest point, where the granite is most worn, and by its constant circular motion, aided doubtless by the stones and gravel carried round with it, has produced this astonishing cavity. The ledge of granite above, and especially below the basin, is furrowed and rounded for a great distance in a very remarkable manner, into troughs bounded by large salient and re-entering curves, and presenting also many subordinate basins of considerable size.

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* See a notice and sketch of this colossal profile, Vol. xiv, p. 64, of this Journal.

The basin is of the same class with the pot-holes at the foot of cataracts, and owing to similar causes; but from the smallness of the stream, and the nature of the rock, a remarkably hard and compact granite, it is one of the most extraordinary cavities of the kind that has been described.

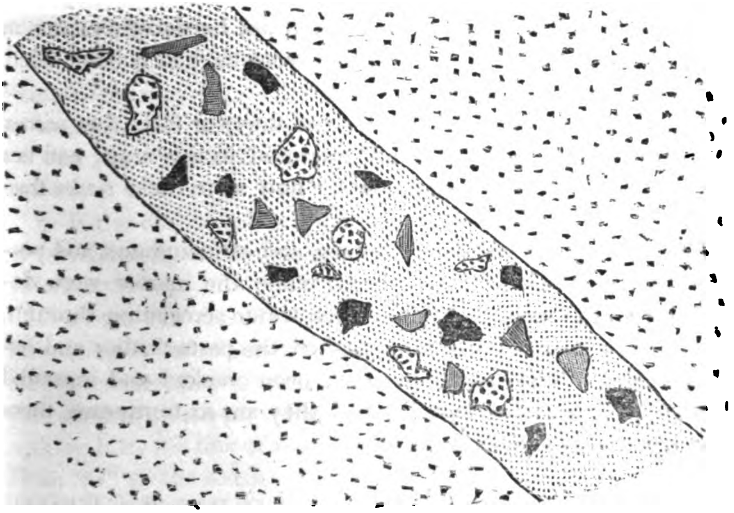
In beauty it may justly rival the Castalian fountain; but as a chronometer it is most interesting to the geologist.

Science has not yet discovered, by experiment and observation, the law of attrition of granite by running water; and the stream that flows here seems utterly inadequate to the production of the effect within the historical period, and would seem to carry back the antiquity of the world to a remote era.

### *Granite Veins in Granite.*

These are very numerous, and on a large scale. There is a remarkable one of this character, on the right hand of the road, just north of the basin. The granite is fine grained, and dark, with mica or hornblende. The vein, on the contrary, is feld-

Fig. 6.



spathic and white, six feet wide, and contains in abundance imbedded fragments of granite, like that enclosing the vein, and also of *slate and trap*, all finely contrasted in color with the vein, and pasted into it like fragments in a breccia. Fig. 6.

The circumstances existing at the time this vein was filled, may have been these. The granite was consolidated, and covered by slaty rocks, (since removed,) and by masses or fragments of trap, which were all fissured simultaneously, and the fragments of all falling into the fissure were entangled in the fused rock thrown up; or the granite was covered with the ruins of slaty and trap rocks, and when it was fissured the fragments torn off were enveloped together with those of slate and trap, and all consolidated. Whatever was the state of things here, the dike is clearly not one of segregation, but of injection from below; and its relative age is certainly more recent than the consolidation of the granite, and the period when the slaty rocks were deposited in this region, or the ejection of trap.

### *Detached Masses of Granite.*

In this vicinity there are numerous detached rocks lying on the ground, and some of enormous size, which are fractured through and through, sometimes in two pieces, sometimes in more, the parts with their salient and re-entering angles exactly corresponding to each other; and thus proving that they were once joined, and have been cracked by violence, and not by decomposition or disintegration: the void being such a space as, had it been filled, would have made a dike.

A remarkable rock of this kind, some thirty or forty feet across, may be seen near the "Flume," fractured in this way, and is a mere boulder. The question arises, "how were these rocks fractured?"

They were once portions of ledges, and of mountains, and perhaps were cracked, but not parted, when the masses were detached from the main body; and then water percolating through, has, year by year, by freezing, pushed the parts farther and farther asunder. They could not have been cracked and separated by earthquakes where they lie, and they are so numerous, there must have been a general cause.

## ART. X.—*Prof.* LOCKE *on Magneto-Electricity, and Electro-magnetical Machines.*

Med. Coll. of Ohio, Jan. 28th, 1838.

TO PROF. SILLIMAN.

*Dear Sir*—I MENTIONED to you in my last letter, some experiments which I was about to make in Magneto-Electricity; I have now finished one series of them, part of which I propose to communicate to the public through your Journal. As it is possible, that some of your readers may not be sufficiently acquainted with the principles of magneto-electricity, to understand fully the apparatus and experiments which I am about to describe, I will take the liberty to prefix a concise statement of a few of the most important elementary principles.

1. Whenever a permanent steel magnet or loadstone attracts a piece of soft iron, it converts that iron into a magnet, so long only as it attracts it, with poles opposite in their character to those by which they are attracted. This takes place when the horse-shoe magnet attracts its "keeper."

2. If the soft iron, thus made magnetical by the attraction of a permanent magnet, be forced off and reversed in position, its polarity or magnetism will be reversed.

3. If the "keeper," or soft iron attached to the magnet be wrapped by an insulated coil or "helix" of copper wire, as a spool is wrapped by its thread, and be applied to, or detached from, the permanent magnet, or be reversed in position so as suddenly to acquire, lose, or change polarity; electricity, at the moment of change, will pass through the coil with its usual characteristics.

4. If the end of a bar magnet be thrust within a coil, or withdrawn from it, an electrical current will be momentarily excited. (Faraday.)

5. Even the feeble polarity excited by terrestrial magnetism on placing a bar of soft iron perpendicularly, and suddenly reversing it, is attended by a sensible evolution of electricity in a coil surrounding that bar. The experiment succeeds still better, by making it in the line of the "dip," viz. with the upper end inclined about 20° to the south.

6. Electricity thus produced by a magnet, is called magneto-electricity.

7. The common magneto-electric machine consists of a wrapped "keeper," revolving almost in contact with the poles of a powerful horse-shoe magnet. This form of the instrument is attributed by Mr. Faraday to Mr. Saxton, now residing in Philadelphia. For figures and descriptions, the reader is referred to the last number of this Journal.

Having premised these elements, I proceed to the subject of my investigation, which was to determine whether more electricity is developed in a coil by passing the included iron abruptly *by* the pole of a magnet, or by passing it *along* from the middle or neutral point of the magnet to the pole, as close as possible to it throughout the whole course, thus exciting the polarity gradually. As I solved the problem with a new instrument which answers several other purposes, I will first describe that instrument and the several uses which I have made of it. I propose to call it the Electro-magnetic Dipping-needle. It was in the first place intended only for class experiments, and consisted of an iron bar eleven inches long, half an inch wide, and one tenth of an inch thick, bound with about twenty five feet of copper fillet, and fastened to a horizontal axis about two and a half inches long, pivotted in two upright brass columns so as to give rotary motion in the plane of the meridian, exactly like the motion of the dipping-needle. On the axis were two copper wheels about half an inch in diameter, insulated, and running in mercury grooves in a piece of ivory, and having the two ends of the copper fillet soldered to them. By connecting the poles of the battery with the mercury grooves it became an electro-magnet, having free rotary motion.

*Class experiment of showing the Dip by Electro-magnetism.*—The needle being placed horizontally, and the poles of the battery connected with the mercury grooves so as to produce polarity, that end possessing north polarity immediately descended to the line of the dip. The wires being changed so as to reverse the polarity by reversing the current of electricity, the opposite end immediately descended to the same line. Thus to exhibit strikingly the effect of terrestrial magnetism in producing the dip, was all that had been so far contemplated.

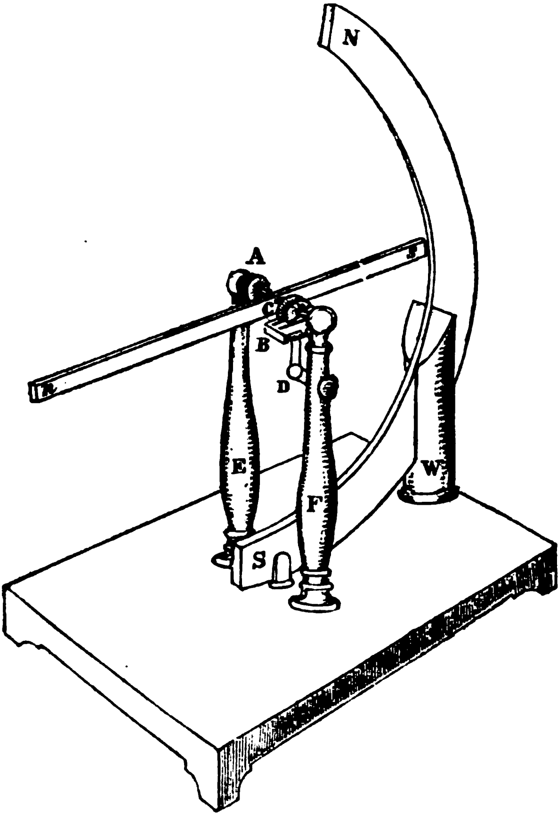
*The Dipping-needle made to revolve by Terrestrial Magnetism.*—I afterwards attached to the axis four semicircular "cams," running in mercury grooves in such a manner that the needle, by its own motion, produced the necessary reversals, when, upon the application of a vigorous calorimotor, it performed one hundred and fifty revolutions per minute, in the plane of the magnetical meridian, thus exhibiting terrestrial magnetism in a very agreeable manner.

*The north end of the earth shown to be virtually a Magnetical south pole.*—While the needle was revolving by terrestrial magnetism, I brought the *south pole* of a feeble artificial magnet to the lower point of the dip, so that the pole of the needle passed near to it. The motion was immediately accelerated. On presenting a north pole at the same point the motion was retarded, stopped, or reversed, according to the strength or proximity of that pole.

*The south polarity of the north end of the earth still more strikingly exhibited.*—I constructed a semicircular steel magnet, the inside diameter of which just permitted the dipping-needle to revolve within it, and attached it in such a manner, that the *south* pole of it was at the lower point of the dip, and bending round to the south had its north pole at the upper end of the dipping axis. The battery being applied, the revolutions were exceedingly rapid, *and in the* SAME DIRECTION *as by terrestrial magnetism.* On reversing the semicircular magnet and bringing the *north* pole at the lower point, the motion was reversed, and CONTRARY to that produced by terrestrial magnetism. In this form, the instrument resembles Messrs. Davenport and Cooke's model, as exhibited last spring in New York, one of their semicircular magnets being removed and the instrument being turned down on one side, so as to bring the diameter of the other into the dipping axis.

*Magneto-Electricity produced by Terrestrial Magnetism.*—Removing the semicircular magnet and the battery, connecting the poles of my thermoscopic galvanometer with the mercury grooves, and giving the needle a smart whirl by hand, say one hundred and fifty revolutions per minute, I obtained a sufficient quantity of electricity to deflect the galvanometer needle 40° by impulse, and that too against a torsion wire six inches long, weighing one third of a grain. And here I ought to remark, that the mechanism used for the reversal of electrical currents, and consequently of the polarity, when the instrument is used as a self-revolving machine, was precisely what was required in producing deflection by magneto-electricity, for it sent the currents all in one direction, instead of producing the alternate or vibrating motion occasioned by the common magneto-electrical machine. It is curious to observe that electro-magnetical engines, moving by the reaction of an electro-magnet and a permanent one, are also magneto-electrical engines. When electricity is supplied to them from a battery, they revolve; and if they be made to revolve by hand or otherwise, they give out electricity; electricity and motion producing each other reciprocally.

*The problem proposed in the first part of this paper, solved by the Dipping-needle used as a Magneto-Electrical Machine.*—Does a magneto-electric helix, or coil, act more powerfully by passing the poles of the exciting permanent magnet abruptly, by moving in a plane perpendicular to that in which the magnet lies, or by approaching the pole of the magnet from the middle or neutral point, keeping constantly close to the magnet itself? I restored the semicircular magnet to its place, still keeping the galvanometer connected with the instrument. Here, as the coil-bound iron needle revolved in the plane of the magnet, and close to it, I had one of the conditions proposed in the question. I adjusted the torsion index so that it required sixty revolutions of the iron needle per minute, to keep the galvanometric needle constantly at the point of strongest deflection, viz., parallel to the coils of the galvanometer; then letting it return freely to its place, I found the torsion to have been 62½°. Taking out the semicircular magnet and placing it in a plane, at right angles to that in which the coil-bound iron needle revolved, so that its convex bend presented to the west, and its poles only were presented to the iron needle at the points of the dip, I obtained the other condition of the question, the abrupt production of polarity. I then proceeded as before, to adjust the torsion index until sixty revolutions per minute would evolve electricity enough to hold the galvanometric needle constantly to the point of strongest deflection, and letting it return freely to its place found the torsion to have been 41°. From these experiments, it appears that the deflecting power, by abruptly passing the poles, is only about two thirds as much as when continuous proximity is preserved. In order to determine whether electricity, produced by inversion of polarity, is in the simple ratio of the number of inversions in a given time, or increases in some higher power, I varied the above experiments, and instead of changing the torsion so as to obtain an equal number of revolutions, I let the torsion remain constant and changed the number of revolutions to produce equal deflection, and found that to maintain a torsion of 62½°, required sixty revolutions per minute in one case and ninety in the other, which being nearly in the inverse ratio of the deflecting forces, I inferred that the deflecting forces are as the number of reversals in a given time.



*Explanation of the Figure.*

*n s*. The electro-magnetical dipping-needle, fastened to an axis pivoted in the two brass columns, E and F.

A. Two copper circles or wheels, to which are soldered the two ends of the coil which wraps *n s*.

B. A block of ivory having two mercury grooves, in which play the two pairs of semicircles of copper, C.

D. The support of the ivory.

N S. The semicircular magnet, supported by the wooden column, W.

The above experiments have a bearing on the construction of magneto-electrical machines, and may possibly account for the effect of those machines, in which the coil is made to revolve at the side of the magnet* instead of acting opposite to the ends of it. It should be observed, however, that the armature or coil-bound keeper, in the common magneto-electric machine, is so short, that it scarcely leaves one pole before it begins to be in contact with the next opposite one. Yet it seems to me, that a magneto-electrical machine with the keeper revolving within, or at the side of, semicircular magnets, joined so as to make a complete circle, deserves a trial. As the evolution of magneto-electricity and the motion of the same instrument used as an electro-magnetical machine seem to be in proportion to each other, it would appear that the construction adopted by Messrs. Davenport and Cooke, in which contiguity is preserved as in my dipping-needle, has superior advantages. Whether such machines can ever be made to compete with moving powers already in use, or to attain the maximum effect of electro-magnetism, is an interesting philosophical problem.

## *Additional Remarks, by* PROF. LOCKE, *on Electricity produced by motion, and on motion produced by magnetic electricity.*

Med. Coll. of Ohio, Feb. 10, 1838.

TO PROF. SILLIMAN.

*Dear Sir*—IT gave me great pleasure to receive yours of the 1st instant. You were pleased to encourage me in the researches which I had begun, and I now sit down to communicate to you a generalization, which I suggested in my letter of the 28th, in which I stated "that electro-magnetical engines, moving by the reaction of an electro-magnet, and a permanent one, are also magneto-electrical engines. When electricity is supplied to them from a battery they revolve, and if they be made to revolve, by hand or otherwise, they give out electricity; electricity and motion producing each other reciprocally." I have since examined that subject more particularly, and find the generalization may be extended still further, and include *all* electro-magnetical motion produced by two magnets, or by a conductor and a magnet. It may then be stated as follows: If a galvanic current from a battery produces an electro-magnetical motion in any piece of apparatus, and that battery be detached and a galvanometer substituted in its place, and connected with the same wire or poles of the apparatus; then, on compelling the same motion in the apparatus by hand or otherwise, the galvanometer will be deflected, showing a current of magneto-electricity in a direction opposite to that current from the battery which had produced the same motion. I have tried the experiment with Barlow's "revolving star,"* the "revolving wire" of Mr. Faraday, the "revolving cylinder," with Andrews' revolving magnet, De La Rive's coil, and also with one galvanometer acting upon another.

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* As in those made by Mr. Clarke, of London, and figured in the last number of this Journal.

The revolving magnet is the most simple magneto-electric machine possible. Take a cylindrical straight bar magnet, and holding two wires from the galvanometer, one in contact with one end of the magnet, and the other in contact with the middle, let an assistant twist the magnet round on its axis, the wires slipping on its surface; the galvanometer will immediately indicate the production of magneto-electricity. Or, the lower end of the magnet may be sharpened into a sort of pivot, and be pressed by the breast down into an indentation in one of the conductors, while the contact at the middle and the rotation of the bar are performed without an assistant. With a magnet eight inches long, and one sixth of an inch in diameter, made of watchmaker's wire, nicely pivoted, and turned by drawing the finger across it, I obtained a deflection of my twelve inch galvanometric needle of sixty six degrees, viz. from N. 45 E. to N. 21 W. It is evident that the galvanometer itself is included in this rule. I connected my large thermoscopic galvanometer, by long wires, with the poles of an elegant and delicate Mellonian galvanometer, and then put the needle of the larger one into rotary motion by hand. The needle of the smaller instrument was deflected quite to the west, while the needle of the larger swept one half of its circuit; and quite to the east, while it swept the other half. Most, if not all, of the elements of this generalization have been before obtained by such distinguished experimenters as Faraday, Henry, Becquerel, Pixii, and others, yet I have not seen it stated in a form so convenient to those who are already acquainted with electro-magnetism, and are just commencing the converse subject of magneto-electricity.

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* This experiment is identical in principle with the mode of Mr. Faraday, the apparatus for which is figured in Brande's Chem. 1836, p. 315.

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## Art. XI.—*Abstract of a Meteorological Journal, for the year* 1837, *kept at Marietta, (Ohio,) in Lat.* 39° 25′ *N. and Lon.* 4° 28′ *W. of Washington City;* by S. P. Hildreth.

| Months. | THERMOMETER. | | | | Fair days. | Cloudy days. | *Rain and melted snow.* | | Prevailing winds. | BAROMETER. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean temperature. | Maximum. | Minimum. | Range. | | | Inches. | 100ths. | | Mean. | Maximum. | Minimum. | Range. |
| January, | 28.00 | 54 | 6 | 48 | 8 | 23 | - | 42 | W., S. W. & N. | 29.20 | 29.65 | 28.75 | .90 |
| February, | 34.70 | 62 | 4 | 58 | 15 | 13 | 1 | 80 | W., S. W. & N. N. W. | 29.25 | 29.85 | 28.65 | 1.20 |
| March, | 41.33 | 70 | 12 | 58 | 19 | 12 | 3 | - | N. W. & S. E. | 29.33 | 29.75 | 28.90 | .85 |
| April, | 45.33 | 86 | 24 | 62 | 20 | 10 | 1 | 17 | N. N. W. & W. | 29.15 | 29.60 | 28.70 | .90 |
| May, | 60.50 | 92 | 28 | 64 | 20 | 11 | 4 | 8 | S., S. E. & N. | 29.30 | 29.55 | 29.05 | .50 |
| June, | 66.83 | 88 | 45 | 43 | 16 | 14 | 7 | 84 | S., W. & N. | 29.20 | 29.50 | 28.93 | .57 |
| July, | 71.17 | 89 | 54 | 35 | 27 | 4 | 5 | 13 | W., N. & S. W. | 29.32 | 29.55 | 29.10 | .45 |
| August, | 69.70 | 88 | 48 | 40 | 21 | 10 | 4 | 84 | S., S. W. & N. | 29.40 | 29.60 | 29.20 | .40 |
| September, | 62.71 | 85 | 41 | 44 | 19 | 11 | 4 | 23 | S., E. & N. | 29.50 | 29.73 | 29.28 | .45 |
| October, | 54.44 | 80 | 20 | 60 | 22 | 9 | 4 | 25 | N. & S. | 29.49 | 29.73 | 29.25 | .48 |
| November, | 48.51 | 71 | 19 | 52 | 21 | 9 | 3 | 30 | N., S. & S. W. | 29.33 | 29.88 | 28.78 | 1.10 |
| December, | 35.57 | 71 | 13 | 58 | 16 | 15 | 3 | 80 | W. & S. W. | 29.30 | 29.70 | 28.90 | .90 |
| Mean, | 51.57 | | | | 224 | 141 | 43 | 86 | | Mean range, 29.31 | | | |

*Observations on the year* 1837.—The mean temperature of the past year has been a degree and a half greater than that of the year 1836; which, although small in amount, has nevertheless had a decided influence on the season. The heat has also been more equally distributed through the year, and not subject to any great vicissitudes. In winter the temperature has at no time been at zero; and in summer it has not risen above ninety degrees of Fahrenheit.

The average heat for the different seasons of the year has been as follows, viz.

| | |
|---|---|
| For the winter months, . . . . | 32.80° |
| " " spring months, . . . . | 49.50 |
| " " summer months, . . . . | 69.25 |
| " " autumnal months, . . . | 55.22 |

The winter has been three degrees warmer than that of 1836; and the autumn five degrees; while the summer has been two degrees cooler, and the spring one degree warmer: thus equalizing the heat, and favoring the growth of the vegetable world. From the cool and wet state of the summer, the wheat crops were ten days later than usual in ripening, and the harvest continued until the fore part of August, while in usual seasons it is completed by the middle of July. The crops of all kinds were uncommonly fine. Indian corn suffered somewhat from the excessive rains in June, thereby preventing its receiving the usual dressings from the plow and hoe.

The blossoming of fruit and other trees was retarded beyond the average period in the spring, but was in the following order: Peach in bloom the 28th of April; pear and cherry, the 1st of May; apple, 5th of May; papaw, black walnut and butternut, the 16th of May; Ribes villosa and Prunus virginianus, the 16th of June.

June and July of this year were remarkable for excessive rains and tornadoes. The bottom lands on all the small streams which rise in the broken country near the Ohio, were overflowed from two to three times, and the crops of grass and grain along their borders either entirely destroyed, or greatly damaged. The loss to the agricultural community was very great.

The amount of rain for the year has been $43\frac{89}{100}$ inches, which is over the mean for this region. The aurora borealis has been seen a number of times during the year, especially on the 25th of January, when it was most grand and splendid; also on the 2d and 3d of June, and 1st of July. We have been visited by no destructive storms of wind or hail, and the year, on the whole, has been a very propitious one to man and the vegetable and animal kingdoms.

Marietta, February 2d, 1838.

## Art. XII.—*Geology of Upper Illinois;* by Charles Upham Shepard, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

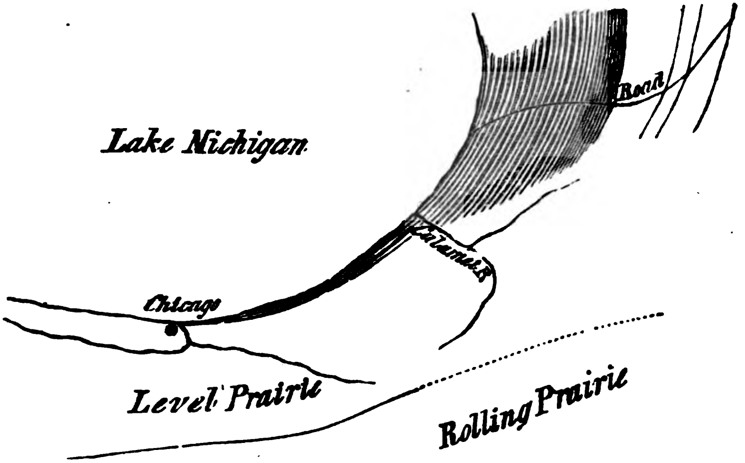
The remarks contained in this memoir are derived from observations made the past season, during a short residence at Rockwell, in La Salle county. Having entered Illinois by the way of Chicago from the northern lakes, I shall commence my observations with some account of this place and its vicinity.

### *Lake-shore near Chicago.*

The western shore of Lake Michigan, above Milwalky, presents no rocks as seen from the lake, being generally level, and but little elevated above its surface. It consists either of a sandy beach, or, as is more commonly the case, of an abrupt bank of blue clay. Chicago is situated on a beach-shore; but the low ridge of sand which formerly intervened between its site and the lake, has in a great measure been obliterated, in order to improve the building lots contiguous to the water. The easterly gales, however, silt up fresh deposits of sand and gravel, which singularly enough for this secondary region, abound in grains of garnet, magnetic iron and epidote, as well as in pebbles of granite, gneiss, sienite and trap. These foreign materials are no doubt derived from primitive boulders scattered over the bottom of the lake.

The city plat scarcely varies from a perfect level, and rises only high enough above the surface of the lake to secure it a bare immunity from inundations during severe gales, and seasons of unusually high water. In the rear of the town lies a broad level tract of wet prairie, still lower than Chicago, being only about ten feet above Lake Michigan. The width of this tract varies from six to nine miles, while it extends as far down the lake as the unobstructed view can reach; and in an opposite direction, follows quite round to the head of the lake, where however it experiences an extraordinary modification from the presence of sand-ridges, which we shall presently describe.

The origin of so extensive a region of lagoon, which is almost completely submerged during the spring freshets, is not easily accounted for; since it is not contiguous to a broad slope of country, or one whose rapid descent might measurably compensate for want of area in giving rise to alluvial deposits. Neither do rivers of any magnitude find their outlet here, which, like the St. Clair where it enters Lake St. Clair, might produce flat plains of considerable extent. Its origin seems to have been connected with a higher level of the lake, when its waters advanced inland quite to the rolling prairie. Nor would this supposition be at all satisfactory perhaps, except for the knowledge we possess of the almost universal, rocky substratum which prevails over the wet prairie, coming for the most part to within a few feet of the top of the ground,—thus giving us the conditions of a hard bottom as forming the shore of the lake, upon which the sediment and wash of the coast was in the progress of ages spread out. The deposit covering this rocky floor, is a horizontally stratified blue clay, on top of which at Chicago, rests a yellowish clayey loam.



On the subsidence of the lake to its present level, the beach-line in the region of Chicago must have begun to form. For a long distance up and down the lake, it is confined to one or two embankments; but on drawing near the head of the lake, by the way of the road to Michigan city, we find the surface of the prairie invaded far inland by a succession of ancient beaches, formed with the utmost regularity as to width and height, as well as conformity to the existing shore of the lake. I shall describe them as they came into view on the stage road, endeavoring to render their character the more intelligible by means of the above sketch, constructed from recollection. Leaving Chicago, the road for about fifteen miles is on the beach, or just behind it, on the border of the level prairie. It then begins to diverge from the shore, and passes obliquely across a succession of ridges, each resembling a turnpike in its rounded form. These ridges are wooded, while the intervals between them consist of wet marsh, or level prairie. Advantage is taken of the ridges as far as possible for the course of the road. After proceeding a number of miles in a south-easterly direction, the road takes a south course at right angles to the coast, and runs for a distance of five miles over about fifty of these ridges. They vary from four to ten rods in width, each one, however, preserving with exact uniformity its own breadth, and separated from each other by intervals of from six to forty rods. When midway between any two beaches, the eye is presented in opposite directions with an almost interminable vista, whose bounding lines of trees are perceived to be slightly curvilinear, the curvature of the ridges corresponding exactly to the broad sweep of the lake shore. No sensible difference of level is apparent in the beaches, while the marshy prairie between them is so low and sunken as to be almost impassable, and apparently corresponds in level with the prairie in rear of Chicago.

At the termination of the above series, commences a new order of ridges, all of which are situated at a somewhat higher level. They have an average width of only one hundred and twenty feet, and are separated by depressions of the same dimensions. In these, both the ridge and the valley are dry and wooded. The road crosses them for the distance of one mile, after which, assuming a more easterly cousre, it descends upon a flat prairie, about three miles wide, from which it rises over a wooded swell of land half a mile wide, and again comes upon a broad expanse of wet prairie. It afterwards turns still more to the east, and continues over high rolling land to Michigan city. As the last fifteen miles of the ride was by night, I cannot record the remaining features of the route.

The succession of beaches described, would appear to have been occasioned by the action of northerly winds operating on the whole range of the lake, thereby producing an accumulation of water in this region, as well as a strong impulsive action upon the bottom of the lake from the motion of the sea towards the shore. In explanation of the existence of but a single beach-line at Chicago, it may very obviously be remarked, that an easterly storm, (the only one that could here produce any effect,) acting simply on the breadth of the lake, would have very little power in giving rise to beaches, compared with gales traversing the entire length of such an immense body of water. Besides which, the line of coast on the western shore is so broad as to prevent the heaping up of the water to any extent, compared with what must take place at the confined extremity of the lake.

It will be an interesting inquiry to ascertain if possible, the length of time requisite for forming a single beach at the head of the lake, since, if this could be settled, we should have the elements for the chronological computation of all the ridges belonging to the first system, above described. Could this be satisfactorily made, the era of the second series might perhaps be found capable of an approximative determination, as well as that of the third and fourth belt, both of which correspond in outline to those first mentioned, and are therefore plainly of lacustrine origin.*

Before dismissing this very striking appearance of the coast connected with the action of the lake, I must be permitted to express the opinion, that a careful examination of the country bordering on the Kankakee and the Des Plaines valleys, will afford evidence of the occasional overflow of the lake at ancient periods, in those directions. It is a well known fact, that the lip of the lake, near its south-western extremity, is at one place so depressed as to permit canoes to pass from the head waters of the Chicago river across to that of the Des Plaines. Nor would the circumstance cease to be an alarming one to the safety of this portion of country, except for the fact that the border to the lake is every where composed of a firm limestone. If then the waters of the lake are still capable of interlocking with those of the Des Plaines, it is clear that at a higher level of the lake, considerable descents of water upon the low country must have taken place. Traces of such incursions appear to exist on the stage road from Chicago to Ottawa, in the general direction of the swells of land on the rolling prairie, and more particularly in the width and depth of the Des Plaines valley, and the immense diluvial accumulations it contains below Juliet.

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* How much farther inland these formations extend, I cannot say; but I should not be surprised to learn, that they prevail under various modifications, quite back to the summit level which turns the waters of the country into the Kankakee, a distance of fifteen or twenty miles.

### *Route of the Michigan and Illinois Canal.*

No internal improvement in the country will surpass in commercial importance the canal which is to unite the waters of Lake Michigan and Illinois river, since it will complete the navigable route from the Gulf of St. Lawrence to the Gulf of Mexico, and open a water communication, so to speak, from the Rocky mountains to the Atlantic coast. The cost of the undertaking in some degree keeps pace with its importance; for although neither the line of its extent, nor the amount of its lockage, is great, still the difficulty which grows out of obtaining an adequate supply of water for the summit division of the route, renders it the most expensive work of the kind ever projected. It is indeed a fortunate circumstance as affecting the certainty of its completion, that the means for defraying its construction are already in the possession of the State, the general government having given the alternate sections of land for five miles on each side of the canal to the State of Illinois, to be appropriated to this important undertaking.

Before speaking of the geological features of the country over which the canal passes, a brief sketch of the route it takes, and the nature of the difficulties it has to encounter, will be given, inasmuch as such a notice will serve in some degree to explain the topographical features of the region.

The canal passes up the south branch of the Chicago river a distance of four miles, thence over the level prairie in a direct line eight miles, to the valley of the Des Plaines river, down the valley of this stream, past the mouth of the Kankakee, to the banks of the Illinois, whose border it pursues for a distance of fourteen miles below Ottawa, where it enters the river. Its length is one hundred and two miles; and it is constructed with a breadth of sixty feet at the water surface, and a depth of six feet. The lockage is all downwards, and amounts to one hundred and forty two feet.

Before adopting the present route, an attempt was made to obtain a supply of water for the summit division, from the Des Plaines, the Calumet, and the Fox rivers; but on running a level from the Des Plaines, nearly opposite the mouth of Portage lake, to the Fox river at Elgin, (thirty-five miles south of the State line,) where the surface of the stream is one hundred and fifteen feet above Lake Michigan, it was found, that the intervening ridge had an elevation of fifty or sixty feet, the cutting down of which would be too expensive to justify the expedient. The commissioners were accordingly led to adopt the magnificent plan of making Michigan the feeder to the canal. The first level thereby becomes thirty-four miles in length, with an average depth of cutting of eighteen feet, which is principally in solid rock. The depth of six feet of water has been decided on, in order to secure to the canal a constant depth of four feet during the fluctuations of tide in the lake, occasioned by high winds. A declivity is given to the bottom of the canal, of one tenth of a foot per mile. There are two locks situated at the end of this level, having a lift of eighteen feet. Above the first of these, for the distance of three quarters of a mile, the canal has a width of one hundred and twenty feet. The estimated expense of this level is $5,871,324.

The middle division of the work extends thirty-seven miles from the head of the first lock. It has six locks, with an aggregate lockage of fifty-seven feet in the first four miles, for the whole of which distance the route is over little better than solid rock, and is consequently very expensive. Another difficult portion of this division commences about two miles below the crossing of the Du Page, and extends nearly to Dresden, below the mouth of the Kankakee. The bluffs here are from one hundred to one hundred and fifty feet high, and approach so near the river as to be washed by it, which renders it necessary to construct the towing path wholly or in part, in the river, for a distance of more than two miles; consequently, an expensive protection will be demanded to defend the work from the ice-floods of the Kankakee.

The western division has sixty-eight feet lockage, and is twenty-nine miles in length, exclusive of four miles of the Fox river feeder. From the first lock, below Ottawa, to the termination of the canal at La Salle, (on *section* fifteen,) the route lies through much wet ground, being along the bottoms of the Illinois, just under its northern bluff. As these lands are overflowed during the spring-freshets, the level of the canal requires to be considerably raised, and to be guarded by strong embankments.

The construction of a canal-basin, at the termination of the canal, with an area of five and a half acres, whose bottom is to be considerably elevated above the present level of the bottom-lands, serves to render this division of the undertaking also, very expensive. The cost of the entire canal, as estimated according to the report of the commissioners, is $8,654,337; but it is admitted that the estimate is too low, it being generally believed that the work will not be brought to a state of completion under ten millions of dollars.

The geology of the chief portion of the route above described, is exceedingly simple and uniform, the great rock formation of the country being the *magnesian limestone;* at least, this is the rock from the commencement of the canal, (four miles from Chicago,) nearly to the mouth of the Kankakee. It also reappears west of the Fox river, as will presently be pointed out, and enjoys a wide distribution probably throughout the whole of Upper Illinois and Wisconsin. A good opportunity for examining its character occurs near Chicago, where the excavations have already been commenced. It here rises quite to the surface of the prairie. It is imperfectly stratified, with an evident dip of 10° or 15° to the north-west. Its color is light grayish white, with a frequent shade of yellow. It is compact in texture, and often slightly cellular or cavernous—a peculiarity which seems to be connected, for the most part, with the profusion of organic remains existing among its materials at the period of its formation. The following is a brief list of the fossils which fell under my observation at this locality: two species of *Orthocera*, a *Turbo* (one and a half inches in diameter) with a depressed spire; a large species of *Pectunculus?;* a *Terebratula*, (with very prominent ribs, and but few in number;) two species of *Ammonites;* a *Caryophyllia*, and a *Favosites*.* Some of the beds are wanting in fossils, and occasionally the rock puts on a shistose or slaty structure, in which case it forms a valuable flagging-stone, which is already employed to some extent in Chicago.

The same rock reappears in the bed of the Des Plaines, twelve miles from Chicago, on the road to Juliet, as well as near the surface of the prairie at Plainfield, nine miles from Juliet, and very abundantly also at this last place. The beds at Plainfield and Juliet, however, are not rich in fossils. The rock is quite close in its structure, and where acted on by the weather, of a yellowish buff color, much resembling the lithographic stone of Sohlenhofen, in Bavaria. The quarries at Juliet, afford it in very even, distinctly stratified layers, whose position is nearly horizontal, their thickness being such as to render it a very valuable building material. I noticed one variety of the rock at this place, which had been thrown out in sinking a well, the appearance of which was very analogous to that of true dolomite, (the gurhofian variety.) Its color is a grayish white, with a tinge of green; throughout the masses were crevices and openings, whose walls were lined with transparent crystals of quartz.

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* Several of these species I am persuaded are new; but I defer a particular description of them until I shall obtain an additional supply of specimens, promised me by Dr. BRAINARD, of Chicago.

The magnesian limestone continues very abundantly in the bed of the Des Plaines, below Juliet, and recurs frequently on the road across the prairie to Holderman's grove, twelve miles east of Ottawa; after which, no more rock was observed until I reached the bed of Fox river, just above the village of Ottawa. At this point, we strike upon the coal formation.

Of the existence of formations more recent than the magnesian limestone in this region, my own observation permits me to add nothing, beyond what has already been stated under the head of the lake shore near Chicago. By the kindness, however, of Mr. W. B. Ogden, the mayor of Chicago, and Col. Thornton, president of the board of commissioners for the canal, I am enabled to annex some additional particulars. The excavations for the canal on the wet prairie give the following superficial formations: one to two feet, black vegetable mould, and two to six feet, yellow, clayey loam, resting on blue clay. On reaching the Des Plaines, the sections give, in the first place, one foot of black mould; secondly, four feet, yellow sandy clay; thirdly, one and a half feet clean black sand, and lastly, twelve feet "vegetable formations with shells."*

The occurrence of boulders in the rolling prairie had often been mentioned to me, under the significant and original appellation, bestowed upon them in this region, of "lost rocks." Their abundance, however, surpassed my expectation. They first attracted attention soon after leaving the twelve-mile house from Chicago, and appeared to form a belt between a quarter and half a mile in width, whose direction was north-west and south-east. In crossing this belt, it was uncommon to pass many rods without encountering a boulder. In general, they were rather more than half buried in the soil. They varied in diameter, from ten inches up to three feet, and belonged to the following species of rocks; granite, granitic gneiss, and trap. A few detached boulders only were noticed between this deposit and Ottawa. Soon after leaving this place, however, another band or patch of them was passed. They were here scattered over the Illinois bottoms so plentifully, as to prove objects of no inconsiderable annoyance in the road. Two miles below this locality, likewise, a number of large masses were seen. Others were occasionally met with south of this point, out upon the rolling prairie, in the direction of Vermilionville. What serves materially to heighten our interest in these boulders is, the consideration that they must have been transported over a distance of between two and three hundred miles, since the southern shore of Lake Superior is the nearest region affording rocks of a similar character, *in situ.*

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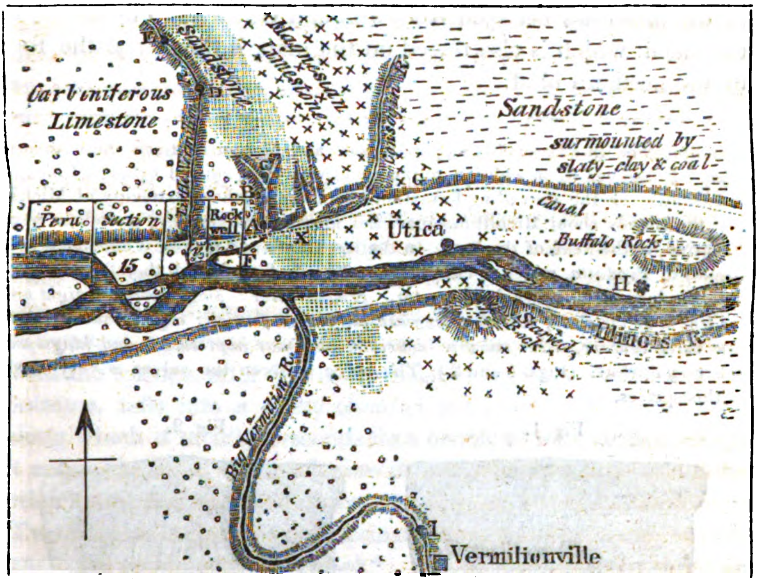
* From the same source, I learn that the magnesian limestone beneath these deposits often abounds with vertical fissures, filled with clay, from one inch to several feet in breadth.

## *Coal Formation.*

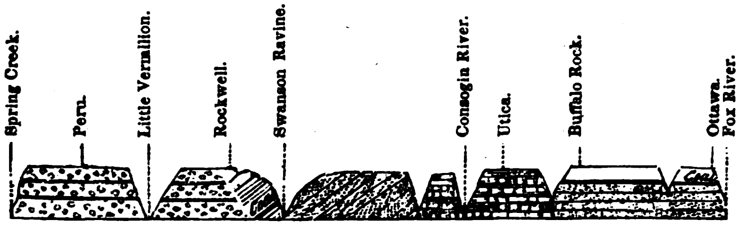
The northern boundary of the coal formation in Illinois, I cannot define with precision, not having been able to explore its limits in detail. As the result however, of inquiries from intelligent persons and such observations as I was permitted to make in the region of the Illinois river, I am led to adopt the following as its general outline :—a line commencing just north of the mouth of the Kankakee and running west, across the Fox river, about eight miles north of Ottawa, and the Little Vermilion, five miles north of Rockwell. Whether it still continues without interruption, across the country to the mouth of Rock river, a distance of about one hundred miles, is uncertain. Coal is found on Green river, however, at a distance of twelve miles above where Rock river enters the Mississippi. It is possible, instead of thus crossing the elevated country to Rock river, that the border of the coal-field simply sweeps round by Princeton, ten or fifteen miles west of Hennepin and Henry, and then descends the Illinois river at about the same distance from its western bank. From the mouth of the Kankakee, the coal passes off in a south-easterly direction to the Wabash, in Indiana, at a point several miles above La Fayette.*

We are now prepared to enter upon a more minute description of the geological features of the country, contiguous to the western termination of the canal, where the coal in particular is largely developed. To render the subject the more easily intelligible, a sketch of the region, together with a cross section exhibiting the north bluff of the Illinois river, from Ottawa to Spring creek, are subjoined.

MAP.



SECTION.



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* In speaking of the boundary of the coal-field, I wish to be understood in general, as treating of its line of junction with the magnesian limestone. Whether the coal-beds run out against this rock, or are continued beneath it, no facts have yet been observed in this country sufficient to show. The extent of the magne-

Rockwell is situated on section fourteen, which is next to the section against which the canal terminates. The width of the Illinois valley varies in this vicinity from one to two miles. Its bluffs, which are generally of naked rock, and nearly perpendicular, are between one hundred and one hundred and twenty feet in height. Their course and position with respect to the channel of the river, may be seen upon the accompanying map. The bottom of the river in the vicinity of Utica is solid rock, with which also the bottom-lands are underlaid at very partial depths. Indeed, the strata often attain the surface over considerable breadths of the meadows between Rockwell and Ottawa. The course of the canal, which is also traced on the map, is directly at the foot of the northern bluff.

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sian limestone in Wisconsin, Upper Illinois, and Missouri, struck me with surprise. I observed it, in addition to the country already noticed between Chicago and Ottawa, as the prevailing formation about the northern extremity of Michigan, the islands about Michillimacinac, the mouth of Green bay, as well as near Navarino, at the head of the bay. In the last mentioned region, it abounded in a species of *Producta*, which I take to be undescribed, and shall therefore denominate the *incurvata*. Specific character. *Semi-circular : hinge nearly straight and the length of the shell; with fine longitudinal striæ; flattish; edge crenated; shallow valve concave, basal margin incurved; muscular impressions and hinge-process very distinct.* (Figs. 1 and 2.) The space between the valves is very small in this species.

Fig. 1.

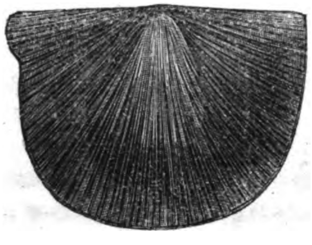

Fig. 2.

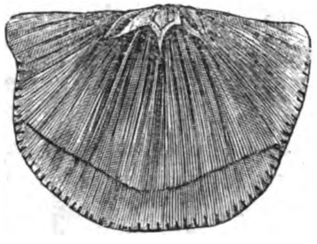

Fig. 3.

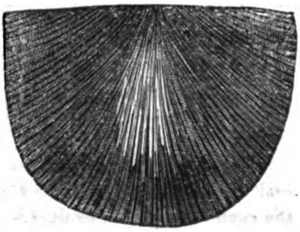

Fig. 3, represents a second species of the same genus, which is also probably new. The large valve is deep and very gibbous. Its striæ are distinct, and resemble the ribs of the Pectens.

Along with these species occurs a polypifera, apparently belonging to the genus *Flustra*.

To the traveller who enters the Illinois valley at Ottawa, after having been satiated with the boundless views of rolling prairie, no scenery can be more novel and enchanting, than that which he beholds between the mouth of Fox river and the town of Rockwell. The first striking object he encounters after leaving Ottawa, is Buffalo-rock, an interesting plateau, whose top corresponds in level with the high prairie, and whose sides are equally precipitous with the main bluffs of the valley. The area of Buffalo-rock is about one square mile. The river sweeps directly past its southeastern base; while the canal, as will appear from the map, is carried along between it and the north bluff of the valley. At a distance of about a mile from this insular elevation of prairie, and directly by the road-side, is situated one of those beautiful mineral springs (of whose chemical constitution we shall presently speak,) for which this part of Illinois is remarkable. Two springs break out within a distance of a rod, both of which occupy the same basin-like depression, whose surface is about five feet lower than that of the adjoining bottoms. The larger of these two springs discharges at least ten gallons of water per minute, and rising through a bed of fine white sand, (which it keeps in constant agitation,) forms a very striking object. The water from the springs, after flowing a distance of fifteen rods over the bottoms, falls into a rocky channel worn out of the sand-rock, along which it rapidly descends for a couple of rods farther, where it enters the river, but not before it has received the water of another spring whose issue is from between the sandstone layers. Two miles after leaving the springs, the traveller is opposite the tragically famous *Starved Rock.*[*] It forms a part of the bluff on the south side of the Illinois, projecting promontory like, quite into the bed of the river, and rising twenty or thirty feet higher than the average level of the bluffs. Its face towards the river is perpendicular, and even overhanging. On some of the maps of the county its height has been stated at two hundred and fifty feet, which is certainly incorrect,—it having recently been measured by Mr. O. W. Jerome, civil engineer of Rockwell, who finds its elevation one hundred and forty feet above the level of the Illinois. The prospect from this point is inimitably fine. A long stretch of the valley, both up the river and down, is at full command. The river here flows over a level rocky floor, and the water is so clear as to enable one to discern the large fish swimming quietly along upon its bottom; while at no great distance, flocks of wild geese, in the most unalarmed manner, occupy the bosom of the stream. A large island, wooded with an almost tropical denseness and luxuriance, is situated in the river nearly opposite to the rock, which greatly adds to the beauty of the scene. Another point of interest occurs in the topography of the valley just before we reach Rockwell. It is where the Consogin river cuts the bluff and enters the meadows. Its present issue is at right angles to the course of the valley; anciently, however, it did not find its exit so high up the valley, by more than half a mile, but on reaching its present mouth, it turned down the Illinois, (still within the high prairie,) and continued nearly to Camp-rock, (X on the map.) The wearing away of the bluff, by the waters which excavated the Illinois valley, in progress of time, however, furnished a new outlet to the Consogin, in consequence of which, a long ridge of prairie stands insulated upon the bottom-lands, whose shape and contiguity to the main bluff render it a conspicuous object. It has been called Chimborazo, and the idea of building upon it a town, as well as upon Buffalo-rock, has even been entertained by some individuals in this region; but of both these situations it may be said, that the inducements to occupy them are rather such as are connected with fine views of valley scenery, than with the actual facilities and conveniences of life. The canal passes directly under the south side of Chimborazo, though it is said to have been for a time debated, whether the better route would not be in the ancient channel of the Consogin. It is, moreover, a singular circumstance relating to the Consogin, that on entering the valley, it soon loses itself, and does not rise into view until it has passed Camp-rock, (X on the map,) when it begins to re-appear in a considerable sheet of water, especially as it enters the town of Rockwell. It here forms, directly under the bluff, a narrow lake, five or six hundred feet in length, by more than one hundred in width, which in seasons of the greatest drought has a depth of about six feet. I am the more particular in describing the situation and dimensions of this strip of water, because, from its particular location in relation to the Illinois river and the canal, it is intended, by means of a short cut across the bottoms in the direction of the dotted lines, (*v* on the map,) to admit boats from the river; and thus at a trifling expense, to convert it into a steam-boat basin. An *improvement* of this nature will have its value greatly enhanced, arising out of the mineral resources so remarkably accumulated at this point, the future development of which is destined to confer upon Rockwell numerous commercial and manufacturing advantages.

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[*] About one hundred years since, a ferocious tribe of Indians, being driven by their enemies upon this projecting point of the Illinois bluff, were reduced to submission by actual starvation.

It is within a few rods only of the eastern extremity of the Consogin basin, that the largest out-crop of coal in the valley of the Illinois occurs. By a reference to our map, a ravine will be noticed as descending from the high prairie, at a distance of about seventy rods from the eastern boundary of Rockwell. This is the Swanson ravine. Its bed is entirely within the coal strata, and very nearly conforms in direction to their basseting edges. The slopes of the ravine consist superficially, to a considerable extent, of soil and loose materials. Slight excavations however, are all that is requisite to reveal the strata, which, on the west side at least, are uniform and continuous up the valley. Commencing at the mouth of the ravine on its western side, we have a good view of the position of the coal-bed, where it has been partially laid open, for supplying to some extent fuel to the vicinity, especially for blacksmithing purposes. The following section was taken at the locality, from the top downwards:—

50 to 60 feet of the superior slope, concealed by soil.
4½ feet gray marly slate-clay.
4 inches argillo-calcareous iron ore.
8 " gray marly slate.
1 foot 4 inches limestone.
1 " 4 " black bituminous slate.
2 feet gray marly slate-clay.
6 " coal.

This brings the coal-stratum nearly to the bottom of the ravine, in which however, a well has been sunk, thereby making us acquainted with the strata for a depth of at least thirty feet more, but showing only alternations of blue and gray slate-clays. The dip of the coal and its associated layers is W. S. W. at an angle between 15 and 20°.

As the State owns the section on which this coal opening occurs, no farther labor has been expended with a view to trace the bed up the ravine, until we ascend to the point B, on section twelve. Here we find a layer of coal two feet in thickness, forming the lowest part of the ravine, and traceable by means of a little gully descending from the east slope of the ravine, quite up to the level of the high prairie, a distance of eight or ten rods. In addition to this stratum, there shows itself at B, on the western slope of the Swanson ravine, and thirty feet above its bottom, a bed of coal four feet in thickness. Both the beds here described correspond, in direction and dip, with the main bed at the mouth of the ravine, nor can it admit of a reasonable doubt that the upper bed (whose thickness is four feet) is a continuation of the great deposit first mentioned.

Still higher up, at C, where the ravine forks, the thick bed has been uncovered in two places, a few rods only apart. The coal here occupies the bottom of the valley, which, it must be understood, is situated at a level at least forty feet higher than at B. In the banks near the openings at C, occur frequent indications of the former combustion of the coal, in the abundance of brick-red slate and porcelain-jasper. Indeed it appears not improbable, that the entire ravine owes its origin to the inflammation of a body of coal near its out-crop, to which water, the exciting cause of combustion, must have found an easy access. In this way a channel may have been formed, which the spring freshets have widened and deepened, until the ravine has been brought to its present dimensions.

Among the loose materials accumulated against the edges of the strata in the upper part of the ravine, I observed an abundance of gypsum, in small white grains, resembling common salt, blended with argillo-marly soil; also frequent balls and kidney-shaped masses of argillaceous iron-ore.

Both branches of the ravine are shallow at C, and in running northward, soon attain the general level of the prairie; after which, the strata of course become concealed by the soil. But by taking the direction of the out-crop to the coal-bed, which is northwesterly, and proceeding a mile and a half across section eleven upon section two, the sandstone which dips under the coal-bed of the Swanson ravine, reappears in slightly cohering strata, and still farther, by a distance of about half a mile, in the same course, at E, we strike the banks of the Little Vermilion, the east bluff of which, for some way, is composed of the identical grit of

Camp-rock, whose direction and dip it likewise exactly imitates. The opposite side of the river, (at E,) moreover, offers us apparently the entire series of slates, shale, and coal, which overlie the sandstone in the Swanson ravine, though the coal has as yet been fairly laid open only at two spots, D and E. At both these places, the thickness of the coal-stratum is four feet. No doubt, therefore, can reasonably be entertained of the unbroken continuity of the coal across section eleven to the Little Vermilion on sections two and thirty-four. The southeast angle of the latter section touches the northwest corner of the former, as the sectional maps of the region will show. In following the river above E, no farther traces of the coal-rocks, are discovered. On the contrary, the magnesian limestone soon takes their place and forms the bed and banks of the Little Vermilion, and of its tributary, the Tomahawk.

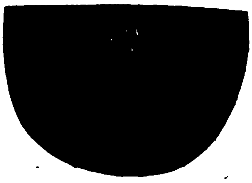
Having satisfied myself of the general direction of the coal north of the Illinois, it became a matter of interest with me to learn whether it obeyed the same law in an opposite direction, viz. in its extension towards the southeast. That this is the fact soon became apparent. The bluff on the south side of the Illinois, a little east of where the Big Vermilion enters, exhibits the same formation as Camp-rock. But no rocks manifest themselves in the line of direction from this place, until we reach the banks of the Vermilion at I, near Vermilionville. Here we recover the coal in the bed of the river, presenting its characteristic thickness, dip, and leading associates, with the exception of the underlie of sandstone, which, if existing, is concealed by loose materials and soil. The coal has the same thickness as at the mouth of the Swanson ravine.

As my travels were extended no farther in the direction of the outcrop, I can only state what I was able to learn from others respecting its course beyond Vermilionville. Abundance of coal is said to occur at several points for ten or twelve miles up the river, all of which may reasonably be considered as belonging to one and the same stratum. Indeed it is not impossible that future researches will prove the extension of the present outcrop quite across the country, even to the Wabash, in Indiana.

The coal at Vermilionville is situated directly in the bed of the river, on its west side, at the base of a very steep portion of bluff, which is at least seventy-five feet high. It consists of five or six alternations of black bituminous shale, with a dark gray, friable, slaty marl, the series being surmounted by a heavy bed of encrinal limestone. The shale is in beds of between three and four feet in thickness, while the clayey marl-strata are considerably thicker. The shale-stratum next the coal, embraces a layer of limestone about ten inches thick. Large balls of limestone also, of a very peculiar appearance, are common throughout the shale. They may be described as flattened spheroids, extremely regular in shape, smooth, and of a black color. They are arranged between the layers of the slate, with their flat surfaces coinciding with the stratification. Veins of calcareous spar, tinged brown by petroleum, divide their surfaces off into quadrangular and pentagonal shapes, thereby imparting to the balls a tolerable resemblance to certain tortoises, petrifactions of which animals they are considered to be, by many people of the neighborhood. In some instances, these balls, which are in reality a species of *septaria*, have a diameter of between two and three feet. The dip of the bed at this place, is about 10° or 12° to the W.

The rock on which the coal rests, as may be seen a little higher up the river, is a light gray, highly crystalline limestone. It occasionally embraces small seams and irregular shaped masses of calcareous spar, and is generally so rich in bituminous matter, as to afford the odor of this substance on friction. But three fossils attracted my notice in it: these were a trilobite, (a species of *Calymene*,) a *Flustra*, and a *Producta*, which so closely resembles a pecten in general figure, as well as in the delicacy and distinctness of its ribs, (56 to 60 in number,) that, believing it to be new, I shall call it the P. *pectenoidea*. (Fig. 4.) The two latter fossils are very common. Of the tribolite I saw but a single sample, and that was presented me by Rev. Mr. Elliot, of Vermilionville. The bluffs on the east side of the river, in the vicinity of Elliot's dam, abound in the relics of the spontaneous combustion of coal, such as hardened slate and detached grains and crystals of gypsum, mingled with clay and marl. It is in the bed of the river near this place, also, that several mineral springs occur, a more particular notice of which will hereafter be given.

Fig. 4.



Before entering into additional details respecting the coal, it will be proper to say something *farther* of the horizontal formation of Rockwell and the Little Vermilion river, beneath which the coal of the Swanson ravine dips. They are well understood, from an inspection of the western bluff of the Little Vermilion, at the saw-mill near the river's mouth. We have here the following arrangement, from the top downwards:—

12 feet limestone.
4 " blue and red slaty clay.
12 " limestone.
1 foot blue slaty clay.
2½ feet black bituminous shale.
4½ " blue slaty clay.
3 inches coal.
5 feet blue slaty clay.
30 " limestone.

In sinking wells in the town of Rockwell, fifty rods back from the bluff, where the surface is about fifty feet higher than it is immediately at the top of the bluff, a succession of clay and marl beds is penetrated before reaching the stratum of limestone first mentioned in the foregoing arrangement. The marl has a dull red color, and is very friable,—falling to pieces, or slacking on a short exposure to the weather. It contains frequent impressions of a species of *Pecten*, (Fig. 5.) and of a second bi-valved shell, (Fig. 6.) much resembling a *Unio*, though it is quite possible it may be a *Mya* or a *Tellina*.*

Fig. 5.

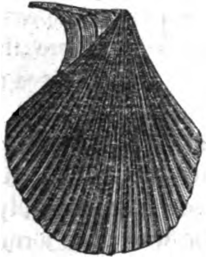
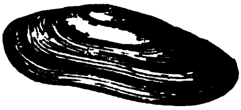


Fig. 6.



The rocks, as they are seen on the face of the bluff at Rockwell, correspond in essential characters with those given above for the Little Vermilion. We observe, however, that the upper limestone strata at the former place are less fine and crystalline in their texture; but possess, on the contrary, a tendency to rapid disintegration, separating into ovoidal or lenticular masses, from two to six inches in diameter. The lower bed is more compact in structure, although it still contains frequent rifts and fissures.

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* The blue slaty clay contains small crystals of iron pyrites, which for a time led to the opinion that gold was also present in the formation. The application of the nicest chemical tests however, fails to detect its existence.

A partial digging has been made into the bituminous shale and coal-seam of Rockwell, which fully proves the correspondence between them and those above described. The shale however, at this spot, afforded distinct impressions of a minute *Patella*, and a perfectly flat valve, (Fig. 7.) with very delicate and almost obsolete concentric striæ, apparently appertaining to a species of *Placuna*.

Fig. 7.

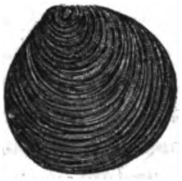
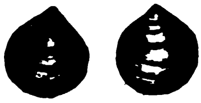


Fig. 8.

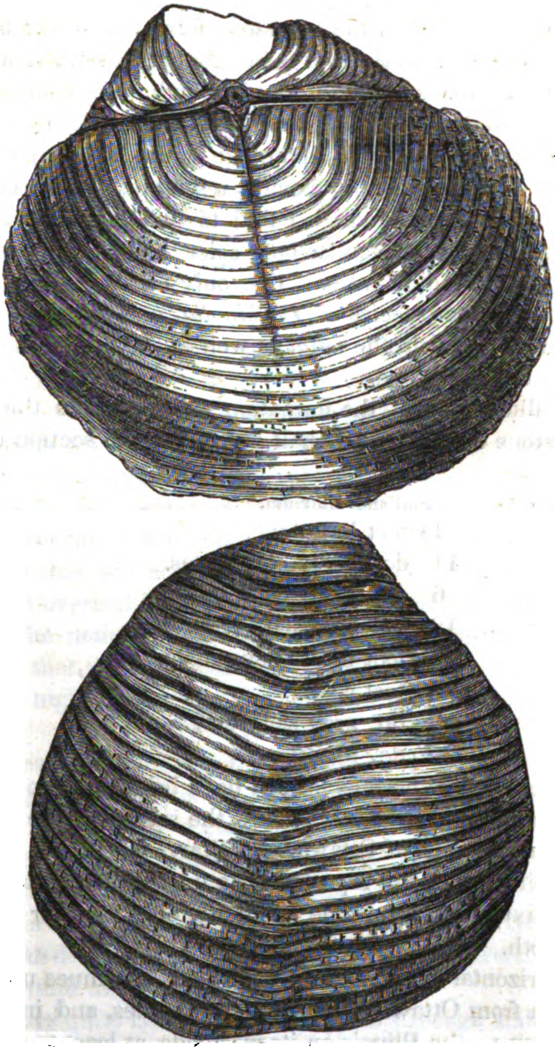


The limestone of the western bluff of the Little Vermilion is a tolerably compact, crystalline rock. It embraces occasionally, as well as the looser variety of Rockwell, encrinal remains, and a small species of *Terebratula*, (Fig. 8.) whose surface is delicately striated, and of a silvery white color and strong pearly lustre. Should it prove to be undescribed, it may be called the *T. argentea*.

An interesting deposit of travertine occurs on the eastern bluff of the Little Vermilion, opposite to the point where the section above given was obtained. The spring which gives rise to the formation, issues from the limestone near the top of the bluff; and the tufa, after accumulating in considerable masses, becomes detached and falls in large blocks into the valley. Among the loose masses under the bluff, I noticed several of a purely siliceous nature, proving, that the character of the water has formerly been different from what it now is, since its present deposition is entirely calcareous.

Two miles farther west at Peru, the limestone becomes still more crystalline, and is quarried into blocks with considerable facility. It here includes several very distinct fossils, among which were recognized Encrinal stems, a large *Spirifer*, the *Pholadomya elongata*, (of MORTON,) and a species of *Producta*, of which a figure is annexed, and which I shall denominate the *semi-*

Fig. 9.



*punctata.* Description.—*Length rather surpassing the breadth: slightly inequilateral. Concave valve with a fold in the middle. Lower valve slightly concave. Hinge-line two thirds the length* *of the shell. Ligamental cavity deep. Flat valve marked by a vertical line extending from the summit half way to the base. Transversely banded. Minutely punctuated; the punctules being impressed, excepting when the shell is entire, the surface is then granose or obscurely hispid.*

The limestone east of the sandstone formation of the Swanson ravine, is the magnesian. It is horizontally stratified and generally without fossils, though often abounding in veins and nodules of hornstone. Ten miles north of Rockwell, near the village of Homer, it is seen to advantage in the banks of the Little Vermilion. It here almost exactly resembles the metalliferous limestone of Missouri, (which I find to be the magnesian limestone also,) having its peculiar buff color, and like it, embracing siliceous seams and nodules. The only fossils I found at this spot were a distinct species of *Turbinolia*, and a part of the vertebral column of a fish, the latter as well as the former, firmly imbedded in the limestone.

For an illustration of the formation which adjoins the magnesian limestone on the east, I shall give a vertical section taken at Ottawa.

Soil and diluvium.
1½ feet limestone.
11 do. marly clay slates.
6 do. sandy clay.
12 do. blue slaty clay.
1 foot bituminous shale.
2 feet coal.
3 do. gray slaty clay.
30 do. sandstone.

And inasmuch as borings for salt have been made to the depth of one hundred and thirty feet below the surface of the river, at a place five miles west of Ottawa, near Starved rock, we are able to say, that the coal is not repeated for a depth of at least one hundred and sixty feet, sandstone being the only rock for the whole of this depth.

The horizontal formation last described, continues up the Fox river north from Ottawa for a number of miles, and in an opposite direction up the Illinois on its west side, at least to the mouth of the Kankakee. The coal of which I heard, as existing in a bed three feet thick near the mouth of the Mazon river, probably pertains to the same stratum as that at Ottawa.

We shall now treat of the economical value of the coal to this region. Bituminous coal is valuable in every part of our country; but to a rich prairie section, where the climate in winter is severe, and where wood is scarcely abundant enough to supply materials for fencing and building, its importance is almost incapable of being exaggerated.

The deposit, upon which main reliance is likely to be placed for coal, at least for a considerable time to come, is the stratum which crops out in the Swanson ravine. This bed will probably be found workable under the entire tract, bounded by the ravine on the east and the Little Vermilion on the west. At what depth below the surface it will be found, situated on the western portion of this tract, it is of course impossible to say; but from what is known of coal-fields in other countries, we are authorized in believing that as the bed is worked down, its present pitch will alter, and that at no great distance from the ravine it will assume a horizontal position.

The thin horizontal bed of coal which has been opened at so many points between Utica and Ottawa, and which is worked at several openings near the latter place, is undoubtedly capable of furnishing a large supply of this fuel. But the difference of expense in working a thin and a thick stratum is so great, especially where the thin bed, as in the present instance, is horizontal in position, and overlaid by a vast accumulation of fissile strata, that it gives to the main deposit an obvious superiority. It is plain, therefore, that the canal commissioners have judged correctly, in affixing a high valuation to the coal-mines of the state on section thirteen.

The coal at Vermilionville, besides being a number of miles from navigable water, is so situated, with regard to the bed of the river in which it occurs, as to render its exploration unusually inconvenient and expensive. It will not, therefore, be likely to come into market, until the supply near the canal and the Illinois river has been to a degree exhausted. No coal is obtained from down the river short of Henry; nor even at this place within several miles of the river.

It appears quite certain therefore, that Chicago and the region bordering on the upper lakes are destined, on the completion of the canal, to receive their bituminous fuel very largely from Rockwell and its immediate vicinity, since there is little prospect of the discovery of any nearer source of supply. At present, the region referred to, is furnished by the coal mines of Ohio, which are situated one hundred miles from Cleveland, on the Ohio and Erie canal. It would seem however, that coal can be delivered cheaper at Chicago from Rockwell, than at Cleveland, for although the distance is the same, yet the dimensions of the Chicago canal and its smaller amount of lockage, will give it a decided advantage over the Erie canal in the expense of transportation.*

The quality of coal, so far as can be determined from the limited exploration thus far made of the Illinois beds, is in no way inferior to that of the Ohio coal. It belongs to the variety of bituminous coal, known in Great Britain under the name of caking coal, in consequence of the property it has of breaking into a great number of pieces on the application of heat, all of which become cemented together into a solid mass or cake. Its color is grayish black. It has a lamellar or foliated structure, the layers separating from each other with great facility at various intervals, from an eighth to three quarters of an inch. Their surfaces often present thin films of what is called mineral charcoal, consisting of the remains of various plants, in which the bituminizing process has not taken complete effect. The cross-fracture of these layers is generally resinous and shining, while the slaty surface is dull. It is very easily frangible. Its specific gravity is 1.273.† It ignites with great facility, and burns with an abundant yellow flame. One hundred parts by weight, on being heated, so long as it burnt with a flame lost 47.5 p. c. in weight; and the residuum after ignition until all the carbonaceous matter was removed, lost 46.5 in addition; thus leaving 6 p. c. of ash, which was white, and consisted of silica, oxide of iron, alumina, and lime.

The ease with which it burns and the abundant flame it emits, must serve to render it a most valuable fuel. For while it will afford a warm and cheerful fuel for the grate, it is peculiarly adapted also to steam boilers, and to all the operations of heating and evaporating fluids. It will also give rise to a coke of a medium quality, the presence of iron-pyrites not being found so considerable as to interfere with its employment by the blacksmiths of the country, who prefer it indeed in their work, to charcoal.

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* Coal is raised and delivered to the boats in Ohio, at four cents the bushel. It sells in Cleveland at from fourteen to sixteen cents, and in Chicago, at fifty.

† One cubic foot of this coal will, therefore, weigh $79\frac{121}{1000}$ pounds, which will give for a bed six feet thick in one acre, nine thousand two hundred and thirty one tons.

### *Mineral Springs and Salt.*

Sulphureous and saline waters appear to be of frequent occurrence in the region of the coal-deposit above described. Copious springs occur at and near Ottawa, particularly on the Illinois bottoms in the vicinity of Buffalo rock. Others again exist in the bed of the Big Vermilion, at Vermilionville, and near the mouth of the Mazon river.

The springs on section twenty three (H,) have already been alluded to. The two which come to the surface near together, and by the road-side, may be denominated saline waters. Their temperature was apparently above that of other springs in the vicinity, and decidedly superior to the mean temperature of the climate. No odor of sulphuretted hydrogen is evolved from either of them, nor do they blacken a solution of acetate of lead. The application of the usual tests, proved them to contain the following principles:—

Carbonic acid.
Nitrogen.
Super-carbonate of lime.
Bi-carbonate of soda.
Chloride of sodium.
" of calcium.
" of magnesium.
Sulphate of lime.
" of magnesia.
" of soda.

The spring issuing from the sandstone layers, nearly on the bank of the Illinois, is a strong sulphureous water; and in addition to the above enumerated ingredients, contains free sulphuretted hydrogen and the hydro-sulphuret of sodium.

Both these springs were tested for iodine and bromine, without discovering either of these substances; although the examination was made on less than a gallon of water. If these principles are present therefore, their proportion must be inconsiderable, compared to the other ingredients.

It is certainly a circumstance which considerably enhances the value of these springs, that one of them is a sulphureous water, while the other two are saline only. Their effects on the animal economy will undoubtedly be different, and a much larger class of invalids may therefore resort to them with advantage. As the country of the Upper Illinois has been settled only a few years, of course nothing has been ascertained from experience with regard to these waters; but from what is known of the constitution of the Virginia springs, it may fairly be presumed, that the use of of these waters will be attended with the same beneficial results, as are experienced at some of those celebrated resorts. The Illinois springs occurring, moreover, in a region distinguished for the beauty of its scenery, and lying directly on one of the greatest thoroughfares in the west, must also have their value much enhanced from these considerations.*

The springs in the bed of the Vermilion, at Vermilionville, (O,) are sulphureous in their character; and at the same time, equally rich in saline matter with the Illinois springs.† They are unfortunately so situated, however, as to make it difficult to obtain a supply of the water they afford, since their points of issue are completely overflowed at high stages of the river. The spring at Ottawa is simply a saline water. I had no opportunity of testing its ingredients, but should judge from its taste that it will be found to resemble in constitution, the main spring on section twenty-three.

A still more valuable resource to the country is fully indicated by the composition of these springs, and the circumstances under which they occur. The large and constant proportion of chloride of sodium they contain, taken along with their occurrence in a region of coal, sandstone, and red marl, leaves no room to doubt, that borings of a suitable depth will lead to the supply of a strong and pure brine well adapted to the manufacture of salt. Nor need any apprehension be felt at the detection of so many foreign substances in the waters of the existing springs, since these will be replaced by chloride of sodium, in the supply to be expected from a greater depth. For it appears to be ascertained in respect to these ancient saline deposits, that the common salt in a state of perfect purity, forms the lowest stratum of the series, while the upper layers and members of the formation, such as marls and clays, abound in the sulphates, other more soluble chlorides, iodides and bromides.*

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* That they were frequented in former times by the deer and the buffalo, is apparent from the remains of the skeletons of these animals found buried in the soil in their immediate vicinity.

† I examined these waters on the spot, and subsequently a sample of them condensed by evaporation, which was furnished me by Dr. Hatch.

To what depth it may be necessary to penetrate in this region, in order to obtain a supply of salt water, may perhaps be inferred from the borings in Ohio, where they work down from seven to nine hundred feet, which is several hundred feet below the level of tide-water at the mouth of the Mississippi. Now, provided the salt-stratum lies at the same level in Illinois as in Ohio, (which perhaps is not an unreasonable conjecture,) the borings in Upper Illinois would not have to be carried as deep as in Ohio, since the surface in the latter region is obviously more elevated than in the former.

## *Iron Ores, Sand, Clay and Soil.*

Argillaceous carbonate of iron in balls, tuberose masses and kidney-shaped concretions, occur in the clay and marl beds of the Swanson ravine; but whether in such quantity as will ultimately lead to extensive iron manufactures, cannot at present be determined, though when the coal comes to be extensively worked, enough ore will perhaps be obtained to furnish the region with a full supply of iron for castings. It is not uncommon to find balls of many pounds weight; while strong indications of a continuous stratum of the ore, several inches thick, exist at the coal opening on section thirteen. Its specific gravity is 3.025, and being mingled with limestone, its reduction will of course be effected with great facility. A sandstone moreover, is at hand for the construction of furnaces, while the coal will afford an excellent fuel to be employed in the process.

Iron-pyrites exists in the large coal stratum in two layers, each about an inch in thickness. As it is a variety strongly prone to decomposition, it can be employed to great advantage in the manufacture of copperas, from which salt, both sulphuric acid and colcothar, may be obtained, should their production be found an object in that region.

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* Report on Mineral and Thermal Waters, by Prof. Daubeny, made to the British Association for the Advancement of Science, in 1836, p. 18.

Clays, well suited to brick making, are abundant in the prairie country; and others, adapted to the manufacture of fire brick and pottery, are found overlying the horizontal coal near Ottawa, and at the mouth of the Kankakee.

Extensive beds of pure, white sand, derived from the decomposition of the sandstone, occur north of Rockwell, near the little Vermilion. It is advantageously employed in the fabrication of mortar and plaster, and will one day lead to the production of the finer qualities of glass.*

The extraordinary crops of grain and potatoes every where obtained from the prairie lands, induced me to submit a portion of the soil to chemical analysis. The sample was taken from eight inches below the surface, and after being thoroughly dried by several weeks' exposure to the air, it afforded the following result on one hundred parts.

| | |
|---|---|
| Water of absorption, - - - - | 8.50 |
| Organic matter, - - - - | 9.50 |
| Silica, - - - - - - | 70.00 |
| Alumina, - - - - - - | 7.50 |
| Carbonate of lime, - - - - | 1.50 |
| Per-oxide of iron, - - - - | 1.00 |
| Carbonate of magnesia,<br>Sulphate of potash, } - - - | traces. |

In depth and fertility of soil, the Illinois prairies are probably unsurpassed by any tract of country in the known world. Fields near Alton have been planted with Indian corn for fourteen years in succession, without the addition of manure, and still continue to yield an abundant crop. The farmer in this region, moreover, enjoys a great advantage in the boundless extent of cleared land within his reach, which permits him on the exhaustion of tracts long under tillage, to bring into cultivation fresh fields, and thus to allow those which are exhausted to recover their strength, by enjoying a fallow. Occasionally also, where the soil is light, as on the Illinois bottoms, near Buffalo rock, gypseous marls, like those of the Swanson ravine and Vermilionville, may be employed with great advantage.

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* A variety of limestone occurs adjoining the canal, a little east of Camp-rock, well suited to the fabrication of water-cement. The precise locality may be learned on application to Mr. Dixwell Lathrop, of Rockwell, a gentleman whose public spirit and intelligence render him of essential service to the region in which he resides.

Already an active and intelligent class of emigrants is finding its way into this most inviting region, and is beginning to reap its advantages. A population of several hundred is scattered over the prairie lying a few miles to the north of Rockwell, where but a few years ago the white man was almost a total stranger. Nor can it be doubted, that as soon as the Michigan and Illinois canal is completed, a fresh impulse will be given to the country, and a speedy development of the resources we have pointed out, ensue.

## ART. XIII.—*Calstronbarite, a new Mineral Species;* by CHARLES UPHAM SHEPARD, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

THE mineral here described was received several years since from Messrs. GEBHARD & BONNY, of Schoharie, (N. Y.) along with specimens of Strontianite, which were noticed by me at that time in an article published in this Journal.* I then regarded the subject of the present notice as heavy spar. Having had occasion however, within a few days, to re-examine these minerals, and meeting with more distinctly crystallized fragments than any hitherto observed, I discover the supposed heavy spar to be a new species, and one moreover which offers in its chemical constitution a very remarkable exception to any saline compound as yet known to exist in the mineral kingdom.

### *Mineralogical Description.*

Massive, in broad, straight, lamellar masses. Primary form, right rhombic prism. M on M=102° 30′ to 103°.

Cleavage, M on T perfect; the latter more easily obtained than the former.

Lustre, vitreous to resinous. Color white, inclining to gray, rarely exhibiting a tinge of reddish brown.

Streak white. Translucent.

Brittle. Hardness=3.25. Sp. gr.=4.20 to 4.22.

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* Vol. XXVII. p. 363.

## *Chemical Description and Analysis.*

When heated before the blow-pipe, it emits a phosphorescent light, and fuses into a white porcelainous mass, which on being laid upon moistened turmeric paper, imparts to it a brown stain. It is partly soluble in hydro-chloric acid with effervescence: and the solution, on being treated with alcohol and set on fire, burns with a scarlet-red light. The nitric solution, on evaporation to dryness, again becomes moist after a short exposure to the air.

A portion of the mineral, in the state of an impalpable powder, was digested in hydro-chloric acid, so long as any matter continued to be taken into solution. The undissolved portion was separated from the fluid, and after careful washing with warm water, was dried and ignited along with powdered charcoal in a porcelain crucible, for one hour. Boiling water was affused, and the clear yellow solution of hydro-sulphuret separated by the filter from the unconsumed charcoal. Hydro-chloric acid was added to one portion of the solution, and after partial concentration by boiling, alcohol was added. It burnt without any indication of the presence of the chloride of strontium. The remainder of the hydro-sulphuret was decomposed by nitric acid, and the solution evaporated to dryness. A minute scale of the salt was added to a solution of sulphate of soda. It instantly produced a cloudiness, nor was the precipitate re-dissolved on the addition of more water. The solid nitrate (obtained by evaporation) moreover, remained exposed to the air for twenty four hours, without sensible deliquescence.

It hence appears that the sulphate contained in the mineral, is neither (wholly nor in part) that of strontita, or lime. The specific gravity of the mineral, taken with the crystalline form it assumes, can leave no doubt of its being sulphate of baryta. We have seen above, that carbonic acid, lime and strontita, are also constituents of the mineral. The quantitative analysis was conducted as follows: the carbonates were dissolved out by nitric acid. The insoluble sulphate was washed, heated to redness, and weighed. The nitric solution was evaporated to dryness and treated with alcohol, having a specific gravity 0.812. The alcoholic solution was evaporated to dryness, and the nitrate of lime decomposed by a white heat. The nitrate of strontita, still moist with alcohol, was introduced along with the filter into a small platina crucible and ignited, whereby it was converted into carbonate of strontita. The results obtained were these:

| | |
|---|---|
| Sulphate of baryta, . . . . . | 65.55 |
| Carbonate of strontita, . . . . | 22.30 |
| Carbonate of lime, . . . . . | 12.15 |

So close is the approximation of these numbers to what would be afforded by a definite compound of two atoms of sulphate of baryta, one atom of carbonate of strontita, and one atom of carbonate of lime, that we are fully entitled to consider this as the constitution of the mineral. The analysis, corrected by the atomic theory on such a supposition, will give the following view, as the more exact composition of the substance under consideration:

| | |
|---|---|
| Sulphate of baryta, . . . . . | 65.22 |
| Carbonate of strontita, . . . . | 20.61 |
| Carbonate of lime, . . . . . | 14.27 |

The chemical sign of the species will therefore be $2\dot{Ba}\ddot{S}+\dot{Sr}\ddot{C}+\dot{Ca}\ddot{C}$.

The trivial name alludes to the three bases entering into its composition. In the natural system, it falls to the genus *Halbaryte*, and I denominate it, specifically, *Polyhalous*, from the number of salts it contains.

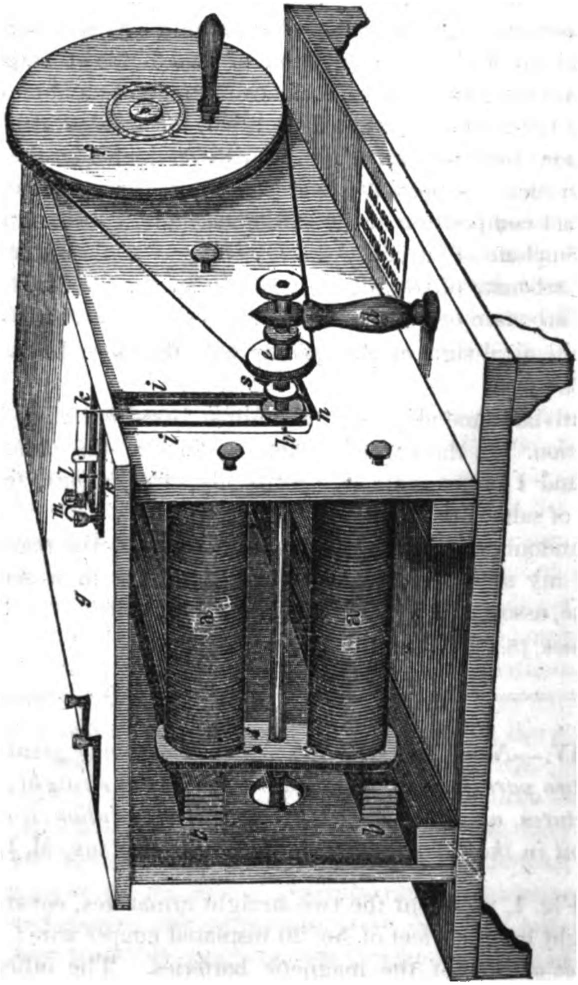
It is undoubtedly a very common mineral in the region from whence my specimens were sent; and occurs in a secondary limestone, associated with crystallized strontianite.

Charleston, (S. C.) Feb. 21, 1838.

## ART. XIV.—*New Magnetic Electrical Machine of great power, with two parallel horse-shoe magnets, and two straight rotating armatures, affording each, in an entire revolution, a constant current in the same direction;* by CHAS. G. PAGE, M. D.

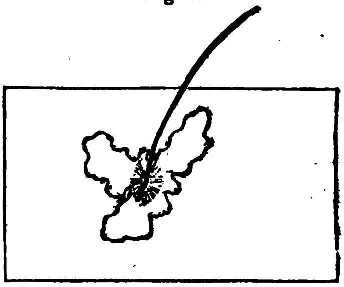
a a, Fig. 1. represent the two straight armatures, covered each with eight hundred feet of No. 20 insulated copper wire; *b b*, the two poles of one of the magnetic batteries. The other horseshoe magnet, exactly parallel and opposite to this, is screened from view by the frame work of the machine. Its poles are the reverse of the former. *c*, is a strong brass strap, for securing the armatures to the shaft. At the other extremity of the armatures, is a similar one, fastened tight to the axis. The strap *c* is held firmly in its position by a nut, but movable, so that the armatures may be removed at pleasure. *d*, is a strong brass pillar for supporting the axis, which turns on centres, secured and adjusted

Fig. 1.



by nuts and milled head screws. There is a similar pillar at the other end of the axis, on the opposite side, but concealed from view by the body of the machine. The magnetic batteries are also secured to the frame by strong brass clamps, and adjusted by milled head screws. *e*, is the pulley wheel, and *f*, the multiplying wheel. *g*, the top board, is secured to the frame by screws, and answers as a convenient table for experiment. The magnets are sixteen inches long, the armatures ten inches, so that the whole machine occupies but little room. The alternating currents, from the semi-revolutions of the armatures, are converted into a current of the same direction, by the application of my *pole changer*. This simple contrivance, beautifully applicable to the magneto-electric, as well as to the electro-magnetic machine, will be found fully described in Vol. xxxiii. No. 1. p. 190, of this Journal. It consists merely of two insulated, metallic, cylindrical segments, secured on the shaft, and two stationary metallic tangent springs for conductors. Silver, about the purity of coin, answers best. The wires from each of the armatures, pass through holes in the brass straps, and through openings in the sides of the machine, to be attached to the pole changers, one of which is seen at *h*. One pole changer would suffice for both armatures, but by using two, the experiments may be considerably varied, as the separate coils may be combined, to form a simple or compound battery. *i i*, are the tangent springs of copper, but tipped with silver where they rest upon the silver pole changer. They pass up through the top board of the machine, and are soldered respectively to the brass straps *k k*, into which are screwed the mercury cups, one of which is of glass for exhibiting the spark, combustion of ether, alcohol, oil, &c. These cups represent the two constant poles of the revolving coils. The circuit is completed and broken by the rise and fall of the curved wire *m*, attached to the little lever *l*. At *l*, the lever is pulled down by a spiral spring. At the other end is fastened a string, which passes down to the lower lever, *n*. This is worked by the revolving pins *n s*, attached to a movable ferule on the shaft. The pins *n s*, are themselves binding screws, so that the ferule may be adjusted in any position, and the circuit broken at any required time. This electrotome, as it may be called, is removed when decompositions are performed, and the platinum wires are inserted into the mercury cups. The machine works equally well, turned either way. I have not yet had opportunity to measure the rate of decomposition of pure water, but it is certainly as rapid as from one hundred pairs of galvanic plates. Pure water is rapidly decomposed when the platinum wires are ten inches apart. A few turns of the wheel furnish mixed gases enough to make a smart explosion. A solution of sulphate of soda in cabbage water, contained in separated glass cells, submitted to the action of the machine, gives immediately the characteristic changes of color by decomposition; reversing the motion of the wheel, the reverse change takes place. The light from charcoal points is insupportable. Plumbago gives an intense light. The metallic leaves burn with splendor. When a wire is suddenly withdrawn from one of the poles or brass straps, a bright spark is obtained, *half an inch* in length. When the circuit is broken from a smooth and clean metallic surface, an entirely new and beautiful appearance presents itself. A diffuse, irregular, nebulous spark, darts along the surface, (as seen in fig. 2,) sometimes in several directions at once, to the distance of half or three quarters of an inch. It succeeds with all the metals yet tried, but best with a piece of iron finely striated with a smooth file. When the lever trip is worked, the secondary current frequently plays with an intense green light, across the separations between the pole changers. The shock from the direct current is uncomfortable with dry hands; but when the secondary current is used, it is painful to touch the poles, even with the fingers. It causes the gold leaves of the electroscope to diverge strongly, without the aid of a leyden jar, or extended, insulated metallic surfaces. It charges a leyden jar at every touch. A charcoal point on the knob of the jar, affords a bright light at every touch. I have some time since shown, that the shocks and decompositions produced by the secondary current of flat spirals and helices in connexion with a single pair of plates, were greatly increased, if the surface of the mercury, (or solid conductor,) from which the circuit is broken, be covered with pure water or naphtha. I have since found that oil gives a far greater increase than either. The rationale is now obvious. When the battery circuit is completed, (as shown by Faraday's discoveries of volta-electric induction,) a feeble secondary current flows in a direction opposite to that of the battery. When the

Fig. 2.



circuit is broken, a powerful secondary rushes in the same direction with the primitive battery current. Hence the bright spark is occasioned by the passage of the secondary through the heated air, occasioned by the combustion of the mercury. Now, if the surface of the metal is covered with a non-conducting liquid, such as oil, the circuit is broken with precision, while an obstacle is offered to the consequent and secondary current, and the greater part of it rushes through the body, or whatever conductor joins the extremities of the coil. The application of this fact is of great value in the use of the magneto-electric machine. If a drop of oil be put upon the break piece of the ingenious machine of Clarke, its power will be greatly increased, while it preserves a good contact by saving the metals from oxidation. I find also, that if the stratum of oil be very thin, the spark is more brilliant than without it, being partly due to the combustion of the oil. The same is true also of charcoal points, when used with the deflagrator or magnetic electrical machine. It will be seen at once, that the gain of power in this new magnetic electrical machine must be very great. I notice in the last No. of this Journal, that Clarke's machine has on one armature four thousand five hundred feet of wire, whereas on one armature of this machine there are only eight hundred feet. The source of this superior action, is chiefly the use of the straight armature, instead of the revolving horse-shoe. There is no advantage in covering a horse-shoe (for electro-magnetic or magneto-electric purposes) beyond the straight portion. Hence the piece of iron is longer than necessary for the full and ready production, and neutralization of the magnetic forces. The straight armature is covered through its entire length, and covered with ease and precision in a lathe.

*On a new compound electro-magnet, for the production of the magnetic electrical spark, and also for attractive force.*—The following positions, I think, may be considered as well established by experiment. 1st. Very long and large bars of soft iron, even with a proportionate battery, acquire a comparative feebler magnetic intensity than smaller bars. 2d. That long and large bars of soft iron, once charged by a battery, retain a greater degree of magnetic power than smaller ones. The great magnet lately constructed by Dr. King of this city, (Boston) in imitation of Prof. Callan's magnet, affords convincing proof of these facts. This magnet is made from a bar of two and one half inch iron, and fourteen feet long. Its lifting power is about one thousand five hundred pounds, and when the battery and armature are removed, it retains a permanent lifting power of fifty pounds. Struck with this curious fact, I was led to the construction of the compound electro-magnet. My first experiment was made with three separate layers of coiled wire round a wooden spool ten inches long, with a bar of soft iron enclosed. This was connected with two pairs of plates and the spark and shock observed. The bar of iron was then removed, and a bundle of annealed large iron wire, introduced in its place. The sparks and shocks were increased to a surprising degree. I then took a bundle of smaller wires four inches long and wound them with only two layers of continuous wire. The spark from this was as intense as that given by the large bar in the spool. I next took seven pieces of good hoop iron, well annealed, one inch wide, one fourteenth of an inch thick and eight inches long. These were firmly rivetted together, and the angles of the compound bar thus made, were rounded to prevent cutting the wire. Four layers of coiled wire were then wound upon it, and their ends attached to two connecting wires. Nothing can be imagined more intense and beautiful than the sparks produced by this little compound magnet. When a piece of iron is burned with it, the ignited particles are frequently thrown off, the distance of two feet, and occasionally fall to the floor. For its size, it is the strongest electro-magnet I have ever known, and when the battery is withdrawn, there is not magnetism enough retained, to affect a very delicate needle. From this perfect neutralization of power, arises in great measure, the intensity of the secondary current. The neutrality is partly due to the reduced size of the bars, but chiefly to the action of their similar poles upon each other, when the exciting cause is withdrawn.

Fig. 3.

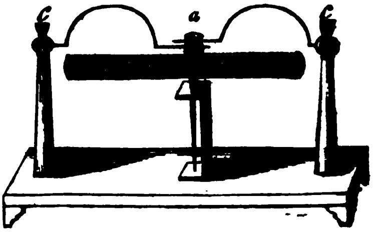


Fig. 3, represents a small electro-magnetic bar, mounted for rotation, with my pole changer attached, which is shown at *a*. *b b*, are the conducting tangent springs; *c c*, mercury cups for connexion with the battery. No stationary magnets are here used, the instrument being made with such delicacy as to revolve by the earth's magnetism. Placed upon the top board of the machine, the connexions being made, it revolves rapidly by the attractions and repulsions of the upper poles of the large magnets underneath.

A small electro-magnet, charged by the three inner coils of one of the armatures, sustained permanently ten pounds, while the machine was in action.

*Fusion of iron filings.*—When a wire from one pole of the machine was placed in a heap of fine iron filings, and a bunch of these raised by a magnetic bar connected with the other pole; the connecting shreds of filings, sometimes an inch in length, became intensely ignited throughout, fused into a mass and fell off, leaving frequently a globule attached to one of the poles, which glowed for a time after the contact was broken, and then exploded, as is seen with particles of iron burning in oxygen. This curious experiment succeeds best, when the filings are held between two opposite poles of magnetic bars, connected each with the poles of the battery.

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## Art. XV.—*On the Dry Rot;* by Phinehas Rainey.

Middletown, (Conn.) March 22d, 1838.

TO PROF. SILLIMAN.

*Sir*—Permit me through the medium of your very valuable and widely circulating Journal, to lay before the public the following facts and observations in relation to the *dry rot* in timber.

It is matter of history, that the timber of the ancients lasted some hundreds of years longer than that of the moderns, and there is no record that their timber was subjected to any artificial process to make it durable. It is therefore probable, the reason why the dry rot exists to such an alarming extent in the heart-wood of the timber of the present day, is to be found in the season of cutting the trees. It is probable that the present general practice of cutting timber in the winter was avoided by the ancients, and that it originated in England, when the botanical theory, that the sap of trees is in their roots at that season of the year, was first promulgated.

It is true, that when trees are cut in the winter months, the albumum will *not* be affected by the dry rot for a great number of years afterwards, and indeed I do not know if it be removed from the heart-wood, that it ever would be affected by that disease in its proper type; and hence the origin of the delusion, and of consequence the practice above alluded to. But in this case, the deadly disease is lurking in the heart-wood, and will, as assuredly as time rolls on, burst forth and destroy its texture in the course of about eight years; and hence the destruction of life and property, and the annual complaint from our government ship-yards. I was once a devotee to the cutting of timber for vessels in the winter, until the following circumstances led me to renounce this ruinous practice.

It was the general custom here, to cut timber for vessels in the winter, but notwithstanding, they went into decay, and wanted repairing in about seven years, or from that to eight, while some of them lasted twelve years. I ascribed this variation in their durability to the fact that the cutting of the timber was often commenced in October, and then continued through the intermediate months into March. I therefore concluded that the right season was in December, when I supposed that the sap was certainly in the roots, and if cut in that season, I believed it would leave the deadly poison in the stump; of consequence, the body and branches would be entirely free from its influence, and I therefore came to the determination to carry this opinion into practice the first opportunity, and one soon occurred.

In 1810, I was concerned in the building of a small freighting ship, of which I was the sole conductor, from her keel until she was completed and ready for sea. According to my previous determination, I commenced the cutting of the timbers for her in the early part of December, and continued it into the first week of January. By so doing, I expected to produce the very best ship for durability on the Connecticut river, where there were then numerous vessels building. The timber selected was white oak, and white chestnut. The vessel advanced, and in April it was found that three of the quarter top timbers were wanting, and (as very crooked pieces were required for these) I was obliged to go into the woods and have them cut. Some time in May, it was found that the stick designed for plank-sheers (this was very large, and intended to make the whole that was wanted) would not answer the purpose, except that it was barely sufficient to go around the bows, the other part being badly rent, and of course was rejected. I therefore went into the woods a second time, when the leaves were full grown and the bark would peel, and had two thrifty white oaks cut for the after pieces. These timbers were put in immediately, and so were the plank-sheers, without any seasoning whatever, and the room between the timber above the air streak was filled with salt, which was supposed to be a preventive against the dry rot. The workmanship was of the first order.

The vessel was launched, and completed in July, 1811. That autumn she went to sea, and after the declaration of the war of 1812, she came to Middletown, and was laid up here until the peace of 1815. In that spring, when she was to be fitted out again, it was found that she must be repaired in her hull; and on opening her, it was perceived that the dry rot had made such destruction among her timbers, that it became necessary to build her anew from her middle wale up. But the three quarter-timbers spoken of, which had been cut green, were sound, and appeared new, although their neighbors on each side of them, were destroyed by the disease; and it is a remarkable fact, that the spikes, when pulled out of them, were bright, and appeared new, but those parts of them which came in contact with the outside planks, (which were made from timber cut in December,) were badly oxidated, so much so, that they were reduced in size nearly one quarter. The plank-sheers forward, which, it will be remembered, were cut in December, were destroyed by the disease, but the after pieces were sound and dry, and the under sides appeared like new timber seasoned in the shade; and what is remarkable as to them is, that although some of the timbers on which they rested were so decayed that they might be picked to pieces, yet there was not the least appearance of it on them, which shows, that although surrounded by corruption, they were themselves, at least up to that period, incorruptible. Thus it can be seen, as respects this vessel, that not only the season of the year, which in the popular opinion is the best to cut timber in, for the purpose of making it last well, was strictly adhered to, but also the precautionary measure of applying salt, which is, even at this day, thought to retard the progress of the disease.

Although it was not thought necessary at that time to repair this ship below the middle wale, yet I have every reason to believe that the poison had begun its work in her timbers, from light-water mark to her top-side, for in 1816 or 1817, in a perfect calm she sank at sea, a poor miserable decayed hulk, a melancholy comment on the folly of cutting timber for vessels in the winter months. By inquiry since, I have always found, that of those vessels that last the longest, the timber of which they were constructed was cut the farthest from December.

The facts in this case entirely changed my opinion. Before, I thought, because it was the general practice, that the winter months were the best season to cut timber in; now I began to reason, to examine, and to compare. I fully believed that the sap was the cause of the dry rot, and wherever that was stored away, at the death of the tree, there would it make its first attack; I doubted, however, the botanical theory, that it is principally in its roots in the winter, and there protected from injury by the frost; for I could not clearly see how the roots of the birch, beach and sugar maple, (although the quantity they will bleed in a season, is partly accounted for in their being supplied by the fibre roots,) could contain their sap; and if they could, how it could be protected from the frost there, any more than in any other part of the tree, when not more than one tenth part of the roots were below the frost. I was therefore determined to ascertain, if possible, where the sap reposed in trees, at different seasons of the year.

Accordingly, having cut a small oak staddle, on or about the twentieth of June, 1815, I placed several pieces of it in the fire-place, and put fire under them; after a little while, there appeared at the ends of the sticks a wet circle, describing the exact thickness of the alburnum, and when they became considerably heated, the steam rushed with violence from the tubes of the alburnum, and there was but a slight appearance of vapor over the surface of the heart-wood. On or about the same day of the month of December, of the same year, I had another small oak staddle cut, and went through with the same process with several pieces of it, and when they began to be heated, the whole surface of the heart-wood, except a small circle enclosing the pith, was wet, but the alburnum was dry, and when they were fairly heated through, the steam rushed with violence from the tubes of the heart-wood, although the whole quantity that escaped was not so large as in the other case. The results of these experiments accord with a known fact in regard to the sugar-maple, namely, that no sap can be obtained from the tubes of the albumum of that tree, and therefore they are obliged to bore the hole for the tube through the alburnum, into the heart-wood before it will run.*

The first experiment shows plainly, that the sap is in the tubes of the alburnum in the summer, and I believe this accords with the present theory in botany; and I believe also, that it is conceded by botanists that the sap is the cause of the *dry rot;* then why was the practice of cutting timber in the winter ever introduced, except for the purpose of economy in saving the alburnum from the rot?

In the second experiment it can be clearly seen, that the doctrine of sap being principally in the roots of trees in the winter, is false, and therefore should be discarded for the mischief it has already done, and the truth should be established, which is, *that in the winter the sap is in the tubes of the heart-wood of the whole tree, roots, body, and branches, and is there protected from injury by the frost.* By what process it gets there, and how protected, is perhaps yet veiled in mystery; but all must confess, that it is conveyed there by a natural law, and thus protected from injury; the beneficent design is too obvious to be attributed to any other than Almighty power.

At the period I was strenuously advocating the doctrine of cutting timber in the winter, I had a small apple-tree which had been engrafted with a choice fruit, and had been growing perhaps seven or eight years. There was one limb on it which I did not like, because it was growing in a wrong direction, and therefore I took it off in December, because of course I did believe the sap to be then in the roots, and therefore at this season there would none of it be wasted or taken away with the limb, and of consequence the branches left would receive a greater proportion of nourishment in the spring. After the occurrence of the circumstances before detailed, I examined the tree, and found that the part or stump of the limb which remained within the surface of the body, was affected by the dry rot in its purest type. I removed this with my knife, and found that the disease had made its attack on the body of the tree itself. The tree, after the limb was taken off, became sickly, and its fruit, after it began to bear, was imperfect.

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* It will be remembered that the sugar maple is always tapped at the close of winter, and first dawning of spring, when there are sunny days and frosty nights. —ED.

I would here observe, that it is the common practice, when people cut the timber of a house frame, to do it in the winter, because, as they think, it will be more durable; but they will not trim their trees at that season because they know by experience that they will contract the rot, and therefore they do it in the spring. What a strange oversight! But Doctor Ives, senior, of New Haven, goes even farther; he trims *his* trees in June, and thinks they do better at that season of the year because the wounds heal quicker. This is right, for as the cause of the disease is *not* in the heart-wood at that season, so the remaining stump, being all heart-wood, can never be attacked by the disease, and therefore the wound will heal quicker; but if it is done in December, the cause of the disease *is* in the heart-wood at the death of the limb, and as the stumps cannot be removed, the consequence is that the disease attacks and very soon destroys *them*, and therefore the wounds will never heal. Although trees thus situated, may, by their abundant foliage, their extended branches, and their smooth and comely bodies, appear to be in perfect health, (which is sometimes the case,) yet they are doomed trees, for the canker having entered into their organization, is preying upon their very vitals, and will sooner or later prostrate them in the dust. If any accident should happen to a limb so as to break it off in the winter, no matter how small, if it be connected with the main pith of the tree, the effect would be the same. And hence the origin of what the carpenters call *punk knots*, that so often appear in our most valuable white pine mast sticks, and the indications of which on the outer surface is many times so minute as to deceive the most vigilant eye, but when perceived and traced, will lead to a mass of decay around the region of the pith.

When I have known the period at which certain trees have been cut, and also their locality, I have afterwards, year after year, examined their stumps, and watched their decay, and have invariably found, that of those of them which were cut in the winter, the disease first made its appearance in the heart-wood, and continued its ravages until that was destroyed, and up to that period the alburnum was comparatively sound. And of those that were cut in the summer, the disease first made its appearance in the alburnum, which, in many cases, after a few years, entirely disappeared, but the heart-wood remained sound and dry. And here let me observe, that in the examination of this description of timber, I have always found it sound and dry, which leads me to believe that this is owing to the peculiar state of the heart-wood at the time of the death of the tree, and therefore it is more impervious to water, which of itself, waving every other consideration, would make it more durable.

Our woods afford many facts which, if rightly examined, would go to show that the doctrine I have advanced is the true one. Trees may be found uprooted and lying prostrate, from which the alburnum has disappeared in consequence of dry rot, and yet the heart-wood remains sound; stumps of dry limbs are observed projecting from aged living trees, which from appearance have been in that situation for ages, and from which the alburnum has also disappeared, yet the heart-wood will be firm and sound; trees are seen standing erect, on the alburnum of which the dry rot seems to have exhausted all its power, and caused it also to disappear, but it had no power to act on the heart-wood; and by their dusky and ragged appearance such trees seem to have been in that situation for a great number of years, and thus it appears that time only was slowly decomposing their outer surfaces, for if examined, it will be found that they are sound and dry within, and much harder than the same kind of timber seasoned in any other way. Can there be any doubt as to the fact that these limbs and these trees received their death in the summer? Others also are found lying prostrate, with the heart-wood entirely destroyed by the disease, yet the alburnum is in a tolerable state of preservation; others present nothing but masses of decay, and in the bodies and limbs of others, holes will be perceived from which once projected healthy branches; and to one that is experienced in timber, these are sure signs that death has entered into their composition, however otherwise their appearance might indicate a healthy state. These trees and these limbs received their death wounds in the winter.

There are numerous facts in the most common transactions of life that will sustain me in my position. I believe that the general practice throughout the northern and middle states is to peel such trees as are to be manufactured into ship plank; by saving the bark, this probably makes the business more profitable than it would otherwise be. It is invariably the case, that by the time the planks become thoroughly seasoned the alburnum becomes so injured by the dry rot as to be unfit to be used; and for my own part I never saw any timber of this sort where the heart-wood was affected at all, unless the tree had contracted the disease before its death. Now I appeal, for the truth of these assertions, to all the experienced ship-carpenters who are in the least acquainted with this kind of timber. The season of peeling is from the third week in May to the second week in June. It is not probable that all the timbers required for a seventy-four, or indeed any other public vessel, are cut in the compass of any one month, but that they commence perhaps in October, and continue the cutting into April, and sometimes into May, and in cases of great emergency, into June. Then, if I am right in my views, various periods must elapse before all the timbers will have been attacked by the disease; and when the planks are taken off from any one of them preparatory to their being repaired, do not the timbers present that appearance? Are there not those on which the dry rot has exhausted all its power and finished their destruction, and others which are less decayed, others not so much? Indeed, the disease can be traced until you find those which seem to defy and continue to defy its energy, even after the vessel has undergone repeated repairs, and these circumstances occur too, even after the timbers have been subjected to some artificial process to make them more durable.

The following is a case in point. In the North American Review, No. xcv. for April, 1837, pp. 343–44, in the article on the Sylva Americana, the following passage occurs. "The white oak was largely employed in the frame of our favorite frigate (the Constitution) which was built forty years ago. In the course of the very thorough repair to which this vessel was lately subjected, many of the white oak timbers of her frame were found in excellent condition; and it is stated on the best authority, that in several instances the timbers of this description were sound, while others by their sides, of the southern live oak, had decayed. Now the superiority of the live oak, in point of durability, over the oak of any other country, has never been doubted." Why did not all the white oak timber last forty years, if there had not been some variation of the season of cutting them? and so with the live oaks.

It is a well-known fact, that the building of the Constitution commenced when we were on the eve of a maritime war with France, or it had already commenced, and therefore we may suppose that the completion of the ship was hurried; and that her frame did not all arrive from the south in time, so that they were compelled to employ the white oak in her construction: probably the season in which it was cut was not much regarded, and therefore some of her white oak timber lasted forty years.

I saw in one of the Reviews of the day a circumstance of this kind, although I cannot now give the reference. In a mine, I believe in one of the German states, the timbers made use of to support the roofs of the galleries, were in a few months destroyed by the dry rot, and this could not be obviated by every experiment that was tried, until they made use of the locust. The effect was accounted for in this way: the dry rot, it is true, destroyed the alburnum immediately; but the decayed alburnum answered for a coating to defend the heart-wood from its influence. If this be the fact, why did not the decayed alburnum of the other timber answer the same purpose? But however, if the histories of those locusts were reverted to, it would most probably be found that they were killed some time in the summer; and it will also be found that if the decayed alburnum be not removed it will generate another disease, which in some respects resembles and is very often taken for the dry rot.

Numerous other instances can be brought to bear in this case. Farmers cut their rails in the summer, when the bark will peel, and they last from fifty to a hundred years. They account for the fact in this way: if they cut them in the winter, the bark will stick to the rails, and after a little while, the water gets under it and causes them to decay sooner. On the contrary, they cut their posts in the winter; probably this is done for the convenience of cutting holes in them at that season, and although their rails last so long, yet their posts begin to decay in about seven or eight years, according to the soil in which they are placed. When from necessity they are obliged to cut a few posts in the summer, (with the expectation however that they will soon decay,) if they last thirty or forty years, (and there are instances of this kind,) they speak of it as a very extraordinary circumstance, but never inquire into the natural cause, nor alter their practice. There are other instances of the extraordinary longevity of timber; wooden abutments to bridges, pumps, piles, foundations of wharves, coffer-dams, &c., a full notice of which would fill a volume, all go to show that there is a season in which to cut timber that will cause it to last for years beyond what it now lasts; and that there is a season in which to cut it, when it will not last over eight years, notwithstanding any artificial process through which the timber may pass.

Immersion in water was one process, that was thought good to make timber more durable, and which was practiced by the British government for a great number of years, and followed by that of the United States, until it was exploded; and according to the English writers on the subject, the life of *their* oaks averaged only about nine years, and that of our own favorite live oaks about the same period. Salt is one of those substances that in the popular opinion is good to make timber more durable, and hence the room between the timbers of every new vessel built by the government, is filled with it. But notwithstanding this, they have to undergo repairs in their hulls in about eight or nine years. So it has been with every artificial process, and so it will be until nature is more consulted, and her dictates more regarded.

Nature no doubt was the preceptor of the ancients, and particularly the Romans, who, it is said, girdled their trees, and let them stand until they were seasoned. Is not this more in accordance with the dictates of nature, than to place timber under water, and let it lie there for eight or ten years, to have its tubular fibres swollen and distended to such a degree as to destroy its elasticity and its firmness, and thereby prepare it for a more rapid decay? And what was gained by that practice? Truly nothing; for, eight or ten years was its life, before immersion, and it is no more than eight or ten years, after its immersion; and in what consists the value of salt, which only cools the outside surface, and therefore keeps it sound, but within, the disease is raging with redoubled violence. The only question is, when *did* the ancients girdle their trees? Was it in the winter? If any other proof is wanting, to show that they did not do it at that season, it may be found in the practice of the pioneers of our western hard wood forests: there, as I have been informed, they used to girdle their trees in the winter, for the very purpose of having them rot and fall down, and thereby save the necessity of cutting them. I think therefore, that we may fairly conclude that the Romans girdled their trees in the summer; and further, that they let them stand until the dry rot developed itself in the alburnum.

If the timbers in ancient buildings were examined closely, the season in which the trees were killed may be pretty correctly ascertained, for if cut in the summer, the powder-post will invariably be found on the alburnum, and if that has disappeared, there will be always some appearance on the heart-wood, that will show that the disease has been there, but never within its surface, and the same is true as regards the dry rot. The result of the following experiments will prove these facts. Cut two saplings, (no matter how small, if there be any heart-wood in them,) one in June, and the other in December. Take one piece of a convenient length from each, and put them into the garret, and one from each and put them into the cellar. In about three years it will be perceived that the powder-post has appeared on the alburnum of the one cut in June; and in the heart-wood of the one cut in December, of those in the garret; and that the dry rot has made its appearance on the alburnum of the one cut in June, and in the heart-wood of the one cut in December, of those in the cellar. By these experiments it can also be seen, that the cause which produces dry rot, under other circumstances will produce powder-post.

Although it is my opinion that June is the best time to cut timber to make it last the longest, yet it is probable that there would not be much difference in its lasting, if it be cut in either of the summer months. But there is a period in which, if timber is cut, the dry rot, or under other circumstances the powder-post, will appear both in the heart-wood and the alburnum, at the same time, although I have seen but few cases of it, and in those cases I had no knowledge of the time of the death of the trees; but I judge it is either late in the fall, or early in the spring, from the circumstance of the bark being closely attached to the alburnum.

It would be satisfactory to know the exact period when the tree was killed, from which the block was taken that is now undergoing the severe ordeal of the fungus pit at Woolwich, England; and if that cannot be ascertained, whether the dry rot first made its appearance in the alburnum or the heart-wood, of its fellow that was destroyed by it; and also to have a block taken from a perfectly healthy tree killed in June, with the alburnum removed and the surface of the heart-wood left perfectly smooth, and without any seasoning put into the pit.

## Art. XVI.—*Additional Observations on the Shooting Stars of August 9th and 10th, 1837; communicated by* Edward C. Herrick.

Since the last number of this Journal was printed, circumstances have prevented me from making any further search for August meteoric showers. Many more doubtless remain to be discovered, but the work of bringing them to light must be left to those who have access to libraries more extensive than this city contains.

In a postscript on p. 364 of the last volume, reference was made to Mr. R. W. Haskins's translation of the Report of M. Arago, (given in the *Comptes Rendus,*) concerning the meteors seen in August in various parts of Europe. The following is an abstract of that part of the Report which relates to the year 1837.

"*Paris.*—M. Arago's eldest son and one of his friends, counted in one hour, beginning 11*h.* 15*m.* P. M. of August 10, one hundred and seven meteors. From 0*h.* 57*m.* to 3*h.* 26*m.* A. M. of the next morning, (August 11,) MM. Bouvard and Laugier saw one hundred and eighty four meteors. The majority of all these radiated from the constellation Taurus.

"*Chateauroux, France,* N. lat. 46° 48′, E. long. 1° 40′.—M. de la Tremblais, travelling in an open carriage, from 10*h.* to 10*h.* 35*m.* August 9, saw *thirty* meteors. He noted but a small portion of the whole number visible. About 10*h.* P. M. August 10, he saw five or six meteors in fifteen minutes."

To the foregoing facts, I am happy to add the following important document, which was given me by my friend Mr. Samuel St. John, soon after his recent return from Europe. It will be noticed, that the observations which it contains, (made by himself and Dr. Parker,) relate to the night of the 9th of August. As M. Arago makes no mention of any meteoric display at Paris on that night, it may be presumed that the sky there was overcast at the time.

"While travelling in Switzerland, in August last, (1837,) in company with Dr. Willard Parker, of Pittsfield, Mass., I had the pleasure of witnessing a remarkable exhibition of *shooting stars.* The phenomenon excited in us unusual interest, but our situation rendered it impossible to observe with as much accuracy and fullness, as we desired. The following is a brief account of our observations.—On Wednesday, the ninth of August, we started from the town of Sion, (Canton of Vallais,) about eight in the evening, seated with the *conducteur*, at the rear of the Diligence, on the outside. On leaving the town, we found the sky entirely clear, and meteors falling in very unusual numbers. Our attention was much attracted by the display, and at five minutes before nine, (by my watch,) we began to count the meteors as they appeared, and continued counting until we had enumerated *three hundred*, when I found the time to be fifteen minutes before eleven, P. M. Here we ceased to count; but from this hour until our arrival at Martigny, at five minutes before 2 A. M. of the next morning, (August 10,) the meteors were apparently no less abundant than while we were counting. Both of us commonly looked at one and the same quarter of the heavens, and I think that we did not in the whole, see a greater number of meteors than a single observer, directing his attention to one and the same quarter of the sky, during that period, would have noted. The part of the heavens towards which we looked, was chiefly the N. N. E., taking in about 30° on each side of that point, but occasionally we included some of uncommon splendor, falling in other quarters of the sky. We remarked that many more appeared on the eastern than on the western side of this point. About one third of the meteors exceeded in apparent size, stars of the first magnitude, and most of the larger sort left behind them trains of sparks. The meteors were mostly of a brilliant white color; many however, were of a reddish hue and some showed a slight tinge of green.

"On our arrival at Martigny, we went to bed, and saw no more. The night of Thursday, 10th—11th August, when according to the report of M. Arago, unusual numbers of meteors were seen at Paris, we spent at the village of Chamonix, (Chamouni.) During the evening, the sky was much clouded, and a severe thunderstorm passed over;—of course no observations on shooting stars could be made. We retired as early as 10 P. M., and I do not know whether at a later hour any observations on meteors were made at that place."

It appears from the above, that in Europe, at least, the meteoric shower of August, 1837, was more abundant on the night of the 9th, than on the night of the 10th. At Paris on the 10th, two observers saw 107 meteors in an hour; while on the 9th, in the

Canton of Vallais, (Switzerland,) two observers, in circumstances much less favorable, saw 160 per hour.

The evidence at present before the public is scarcely sufficient to decide whether in general the August meteoric shower occurs on the night of the 9th or of the 10th of that month;—the date being reckoned according to the time of Western Europe or of the United States. During the present period, the night of the 9th will probably be found to be nearest the maximum. On leap-year, for obvious reasons, the meteoric showers may be expected to happen at a date somewhat earlier than on the common years succeeding.

The paper on ancient meteoric showers, promised on p. 358, of the last volume, will be completed as soon as practicable. It now comprises fifteen instances, viz. Ante C. 25, 29, A. D. 531, 744 or 747, 764, 901, 902, 935, 1094, 1095, 1096, 1099, 1122, 1202, 1243. To determine the precise dates of all these, according to the Gregorian or any other Calendar, requires much time. It appears certain, that some centuries since, the April and the August meteoric showers occurred at a date several days earlier, and the November shower several days later, than they do during the present period.

Since the preceding was written, I have received from Mr. R. W. Haskins, of Buffalo, (to whom the public are much indebted for his frequent communications through the *Daily Commercial Advertiser* of that city, of the earliest French intelligence regarding meteors,) his translation of M. Arago's Report to the Academy of Sciences, Oct. 16, 1837, on the meteors of November and of August. The details of the latter there given, in a letter from M. Wartmann, of Geneva, do not materially disagree with the facts above stated.

I have space only for the following particulars. On the night of Aug. 9, 1837, two persons on an excursion to Chamonix, saw from 9*h*. 30*m*. to 10*h*., more than forty meteors of great brilliancy. At Geneva, on the same night, from 9*h*. to 12*h*., eighty two meteors were seen. At 10*h*. they fell rapidly, and seemed to radiate from a point between $\theta$ Bootis and $\alpha$ Draconis. Twenty miles from Geneva, the meteors were seen in much greater numbers.

New Haven, Conn., March 16, 1838.

## MISCELLANIES.

### GEOLOGY.

1. *Outlines of Geology, prepared for the use of the Junior Class of Columbia College;* by Jas. Renwick, LL. D. Prof. of Nat. and Exp. Philos. and Chem.: large 12mo. pa. 96. Printed by Henry Ludwig, 1838.

The author divides his subject under,

I. Physical Geography—which inquires into the form and external characters of our globe.

II. Geognosy—which examines the nature and relative position of the materials which compose its external crust.

III. Geogeny—which investigates the manner and order in which these materials have assumed their present position.

*Physical Geography* is treated under the following heads:

1. Of the figure and density of the earth.
2. Of the temperature of the crust of the earth.
3. Of the distribution of land and water on the surface of the globe.
4. Of the inequalities of the land.
5. Description of the two great continents.
6. Of rocks and fossils.

*Geognosy.*—The formations are divided as follows:

Modern formations, under six orders. I. Alluvial. II. Chemical. III. Diluvial. IV. Volcanic.

Ancient formations are either stratified or not. Stratified formations are included under five orders: I. Superior. II. Supermedial. III. Medial. IV. Submedial. V. Inferior.—Ancient rocks not stratified are included under six orders: I. Granitoid. II. Porphyritic. III. Ophiolitic. IV. Trachytic. V. Trap. VI. Volcanic.

*Geogeny* is not divided, except under paragraphs and pages. Of the latter there are 18; of the former, 20.

Physical Geography occupies 25 pages, and 54 paragraphs. Geognosy, 53 pages, and 139 paragraphs.

It will be seen that the above scheme covers the whole subject. To give even its outlines within the limits of 100 pages, requires of course great condensation. This has been effected by

Prof. Renwick, whose established character would lead us to expect what we actually find, not only precision and perspicuity, but also a graduated reduction of this great subject to a proportional scale, so as to preserve the harmony and distinctness of the parts, while there are citations of well ascertained facts sufficient to excite interest, and create conviction. In connexion with a course of lectures, properly illustrated by specimens and drawings, this elegant little work must prove extremely useful, as it may be said to be truly classical in its character; and we have no doubt that, for the classes of other institutions than the one for which it was prepared, and even for intelligent popular audiences, it may prove a valuable substitute for the larger geological treatises.

In relation to a work in which we find so much to approve, we have no disposition, as there is no occasion, to criticise; but we will state a few queries and suggestions, that have occurred to us during the perusal, and should the respected author see fit to answer them, the pages of this Journal are at his service.

With respect to the heights of mountains, we would inquire for the authorities that give an elevation to Nevado de Serata in Peru of 25,250 feet, and of Illimani 24,000; and more especially, we inquire in relation to the height of the mountains near the sources of Columbia, which are stated to yield very little to those of the Himmalaya peaks. This last statement is based upon the observations of the surveyors of the Hudson's Bay Company, but not having seen the details, we are not informed whether they are trigonometrical or barometrical, or if accurate observations have not been made, we should like to know upon what probabilities the conclusions are founded, and we are persuaded it would be gratifying to the public to be more fully informed. It has been heretofore supposed that Mount Washington, in New Hampshire, is the highest land in North America this side of the Rocky Mountains, and of Mexico; and in a recent ascent up the former mountain we have supposed this to be true, (see pa. 80 of this No.) We are not informed by Prof. Renwick what mountain in North Carolina is 7000 feet high, and on what evidence the conclusion rests. In relation to iron, which is mentioned as the only metal found in quantity in alluvial formations, it may be asked whether the alluvial gold of Africa, and of the middle geological region of the southern States, as well as of other auriferous regions, and the deep beds of stream tin of Cornwall, do not form an exception to the universality of this statement? With respect to *extinct* volcanoes, the word is not, it is true, used by writers very definitely; but we have been accustomed, with Dr. Daubeny, to regard all volcanoes as active which have been eruptive within the limits of history, or of credible tradition; neither of which will apply, for example, to Auvergne.

With respect to the coal formations, we believe that the existence in certain situations of marine shells, if not of marine plants, is admitted, implying perhaps only an estuary or occasional flooded or sea shore communication with salt water, while all agree that terrestrial organic forms are almost the exclusive ones in these deposits.

### 2. *Geological Reports.*

To those of us who were among the pioneers in American Geology, who began to observe and enquire when there were few or none to lead and direct; who looked out on the solid world with inquisitive, but with almost despairing gaze, since none could tell us what we saw, and there scarcely existed even the rudiments of cabinets to aid our enquiries—it is most gratifying to see, that the first third of the present century has brought into the field a phalanx of explorers in geology and natural history, respectable indeed for numbers, but still more respectable for knowledge, zeal, perseverance and success. The general government has prompted various explorations in its unappropriated wilds; companies and individuals are appealing to geologists to examine their mines and various supposed or real treasures, and several of the States have, by law, provided for an accurate reconnaissance, or a detailed and generalized survey of their respective territories. From the Canadas we have many interesting observations, chiefly by gentlemen connected with the British army, or in the civil service; Nova Scotia was explored some years ago by Dr. Jackson and Mr. Alger; Dr. Jackson is now executing the geological survey of Maine; Massachusetts has been fully described and delineated by Prof. Hitchcock, and Connecticut by Prof. C. U. Shepard and Dr. Percival.* Vermont, New Hampshire and Rhode Island,* among the New England States, have not yet acted, but we trust they will ere long follow the example of their immediate neighbors, as well as of the more remote sister States. New York, New Jersey, Pennsylvania, Virginia, Maryland, Tennessee, Michigan and Indiana, are now in the full career of successful investigation under able corps, or able individuals, whom we have either already named, or expect to name in appropriate notices. Kentucky has taken the first step in authorizing a reconnaissance, and making a commencing appropriation of money, while the movements and demonstrations by colleges and other institutions, and the current of remark in the prints and in conversation, indicate a state of public feeling which almost assures an extension of geological exploration, as well as of kindred research in other departments of natural history, which we may confidently expect will eventually pervade the American Union. The popular sentiment, influenced by individual cupidity, or more enlarged views of public advantage as regards physical resources, is raising this subject almost above the contentions of party, and is almost a solitary point of agreement among those who can agree on nothing else. Almost half the States in the Union have authorized surveys by law, and the number will doubtless be yearly augmented.

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* The report of the latter, although drawn up, is not yet published; that of the former was cited in our October No. (1837.)

In this view, science (not regardless however, of positive advantage to individuals or the community in gainful discoveries) still exults more peculiarly, in the extension of her sway, and in the discoveries that are constantly made, thus extending or correcting our elementary knowledge. The outlines,† once ably and correctly drawn, the fillings up will be always in progress, until detailed descriptions of particular districts, and even of individual mines and quarries, will accumulate in the treasuries of local and economical geology.

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* Notwithstanding many valuable observations made in each of these States, and published by various individuals. Prof. Olmsted, now of Yale College, then of the University of North Carolina, Chapel Hill, deserves to be mentioned with honor, for having several years ago, brought to light many very interesting and valuable facts respecting that State. We have also various reports on the Gold Regions of the southern and southwestern States, and many other detached facts and observations from States and Territories not hitherto explored by public authority; and of these, not a few may be found recorded in the various volumes of this Journal.

† The services of William Maclure on this subject, will never be forgotten.

Drawing near to the limits of our time and space, when very recently most of the geological reports of the season came in, we shall give them such notice as may be in our power. In Vol. xxxii. No. 1, several of the geological reports were mentioned one year since. We have not received the continuation of all of them; those of Maine* and New York, of Maryland and of Virginia, for the present season, have not been received, while those of Ohio, of Pennsylvania, of Indiana, of Michigan, and of Tennessee, are before us.

*Tennessee*—4th Report, by G. Troost, M. D., Geologist to the State, Prof. of Chem. Min. and Geol. Nashville University, Member of the Geological Societies of France and Pennsylvania.

This report is confined chiefly to the rock formations of the district of Ocoee, of which a colored map and section are given on a scale of 21 inches by 19. This district lies in the S. E. angle of Tennessee, touching Georgia on the S., North Carolina on the N. W., the Tennessee river, the Hiwassee river and ranges of mountains.

Dr. Troost gives a preliminary sketch of elementary geology, with occasional illustrations from local facts, which occupies about half the report. He informs us, that in Tennessee there are no strata between the coal and the marl or green sand of Europe; all the intermediate sandstones, oolites, &c., which make so great a figure in England, are wanting in Tennessee, and it is not certain that they have been found any where on this continent. The order of arrangement exhibited in the section presented by Dr. Troost, is, beginning below, primordial rocks, grauwacke, mountain limestone, coal measures. It appears that in Tennessee "the grauwacke series is overlaid by an immense deposit of sandstone, which forms isolated ridges and mountains," unstratified so far as appears, color gray, and no organic remains; this rock he regards as equivalent to the old red sandstone of European geologists.

The carboniferous or mountain limestone is the most extensive of the rocks of the western country, and the most replete with organic remains; there are many varieties of rocks connected with it, and next above lie the coal measures, composed chiefly of strata of coal, sandstone and shale, with large deposits of argillaceous iron ore.

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* A partial report of some important facts in Maine, is given by Dr. Jackson in our last number.

The rocks in the Ocoee district are arranged in the order named above. The glossy aluminous slate it was found had been mistaken for plumbago; but near the same place (Citico creek) there is a bloomery for iron, and decisive indications of iron ore; the bloomery is supplied chiefly from banks about two miles off. Tellico river rolls in constant rapids, in its course towards the Tennessee, and forms a cataract about two hundred feet high, and bears along gold and other valuable minerals. Dr. Troost was present in 1831, when gold was found there for the first time; the quantity hitherto found is small, quantities being derived as is supposed, from the primary mountains of North Carolina, whence the Tellico comes. Dr. Troost thinks there is much less gold in the Ocoee district than has been generally imagined; still there were parties of diggers that sustained their rights by force, and the usual delusion prevailed of inferring ores from Jack with the lanthern and other lights being seen, and from explosions being heard; and the divining rod (a forked twig of hazel or peach tree, which, as they assert, turns in the hand of the adept when he approaches the hidden treasure) was much relied upon. Carnelian has been found among the transported ruins of the Tellico, and good roofing slate and ornamental marbles abound in East Tennessee.

Dr. Troost has made a valuable collection of organic remains, and his report contains in a note an important catalogue of them. His name is sufficient authority for their accuracy.

*Pennsylvania.*—The second annual report, by Prof. Henry D. Rogers, State Geologist, presents the following divisions of the subject: Of the seat of the operations of the survey—Mode of conducting the geological observations—An outline of the geological structure and mineral resources of the north-eastern half of the Appalachian region of the State.

Formation No. I.—Sandstone of the South Mountain.

II.—Limestone of the Kittatinny Valley.

III.—Slate of the same valley.

IV.—Sandstones and conglomerates of the Kittatinny or Blue Mountain.

V.—Red and variegated sandstones and shales of the valley N. W. of the Kittatinny mountain, and of Montour's ridge.

VI.—Blue limestone along the northern base of the Kittatinny mountain, and along both sides of Montour's ridge.

VII.—Sandstone of the first ridge north of the Kittatinny mountain.

VIII.—Of the olive colored slate of the valley between the Kittatinny and second mountains.

IX.—Red sandstones and shales of the S. E. slope and base of the Alleghany mountain.

X.—Sandstones and conglomerates of the Second mountain, and of the S. E. summit of the Alleghany.

XI.—Red shale of the anthracite coal regions.

XII.—Conglomerates and sandstones immediately below the coal measures of the anthracite, the Broad Top and the Alleghany coal region.

XIII.—The anthracite coal measures.

General observations and concluding remarks.

This survey is detailed, both topographically and geologically, and we doubt not it is exact. Prof. Rogers has, in the main, avoided theoretical speculations, and comparisons with European systems and equivalents, wisely reserving these things for his general digest when his labor is through. Still, his remarks upon the anthracite coal beds furnish some bold and decisive speeculations as to elevations and other movements, which, however startling they may appear to an uninitiated mind, are without doubt founded in sound principles of geological dynamics, and we believe are substantially true. Having had some opportunity to examine parts of those vast coal fields, we have seen enough of the evidence of the exertion of irresistible, elevatory, disrupting and compressing or sliding forces, to convince us that no assumptions of that nature are in this region in the smallest danger of being extravagant; and it remains only to infer by just induction from the phenomena, the particular modus operandi in which the power has acted to produce its indubitable effects. Prof. Rogers has been zealously and efficiently assisted in his labors by Messrs. Samuel S. Haldeman, Alexander M'Kinley, Charles B. Trego, and James D. Whelpley, and in the chemical department by his brother, Dr. Robert E. Rogers. The sub-assistants were Messrs. Alfred F. Darley, Edwin Haldeman, Horace Moses, and Peter W. Schæffer. This able report is comprised within ninety three pages, and is furnished with a glossary, and a shaded sectional arrangement of the strata, in the following ascending order, beginning upon the common basis of the primary rocks. The contents of each particular formation are given in the descending order.

I.—Compact white sandstone—1000 feet.

II.—Blue limestone, with beds of chert, and a few fossils—6000? feet.

III.—Roofing slates, dark slates, and argillaceous sandstones, a few fossils, bed of limestone—6000 feet.

IV.—White sandstone, fucoides—1800 feet.

V.—Red and variegated (fossiliferous iron ore,) shales and sandstones (fucoides)—3000 feet.

VI.—Blue argillaceous limestone (fossils)—900 feet.

VII.—Coarse white sandstone (cavities of fossils)—700 feet.

VIII.—Olive colored slate, and gray argillaceous sandstones—5000 feet.

IX.—Red shales, and red, gray and buff colored argillaceous sandstones, a few marine fossils—6000 feet.

X.—Sandstone and conglomerate—2000 feet.

XI.—Red shale, thin calcareous conglomerate—3000 feet.

XII.—Siliceous conglomerate—1400 feet.

XIII.—Coal measures, consisting of seams of coal, dark shales, argillaceous sandstones, and siliceous conglomerates; vegetable fossils—6750? feet.

Total thickness in feet—42,550, or over eight miles of exterior crust, stratified on the primary.

*Michigan.*—Report of Dr. Houghton, 37 pages.

This young State has set a laudable example, in ordering a geological survey, under Dr. Douglass Houghton, which he has carried on with peculiar zeal, considering especially the great physical difficulties of a country, much of which is still in a state of nature. The State is in its infancy, and although rapidly filling with an intelligent population, it is still, with the exception of a few counties, only sparsely peopled by those who have been too much occupied with more urgent necessities, to give even a moderate degree of attention to the mineral objects around them; for this reason, the amount of local information imparted by the people was limited, and not always free from error. Dr. Houghton remarks, that there are on the peninsula no mountain chains, no lofty mural precipices, or deep valleys, where a glance will reveal the structure, and even quarries of stone (for there are very few on the surface) have been scarcely opened. To those parts of the State which are geologically the most important, there are no avenues, except by the streams and the trails of the Indians. "The ascent of a rapid stream by a canoe (the only feasible mode of travelling, and the only manner by which examinations can be satisfactorily conducted,) is attended by fatigue, labor and hardships, of the most severe kind. Wading the streams by day, and annoyed by musquetoes at night, separated for weeks together from all society, were it not (he remarks) that the mind is completely occupied in the contemplation of objects, which, from their symmetry and beauty, furnish a constant mental feast, there would be nothing which could possibly compensate for the hardships endured." In addition to these difficulties, which are not easily conceived of by those who explore a country full of conveniences and comforts, we are sorry to learn, that "the appropriation for the past year has not been sufficient to cover the *travelling expences* of those engaged in these arduous duties." This ought not so to be, and if we had cause, on a former occasion, to enter our protest against the narrow provision made for a similar duty in the most powerful and opulent State in the Union, we need not so much wonder at the caution of a young State, which however, we trust will prove by an enlarged appropriation, that she is not behind in liberality and justice, especially where they are so well deserved as in the present instance.

The rocks of the peninsula of Michigan consist, "for the most part, of nearly horizontal strata of limestones, sandstone, and shales, giving character to a beautifully varied succession of hills and valleys, as also to a soil admirably adapted to agriculture." That part of the State bordering on Lake Superior, presents occasionally primary and trap rocks, forming mountain chains, with strong marks of disturbance since the deposition of the red sandstone.

The divisions of his subject, stated by Dr. Houghton, are as follows:—Upper sandstone of the peninsula; gray limestone; lower sandstone, or grauwacke group; coal; gypsum; brine springs; clay; sand; bog iron ore; mineral springs. The sandstone belongs to the carboniferous series; the rocks appear to have been shattered, as if by convulsions, their ruins forming deep loose masses, and being mixed with the soil. Shale is found mixed with fragments of coal, and occasionally containing thin seams of it.

In the counties of Ingham and Eaton there are thin beds of coal from half an inch to three inches, and even one foot in thickness, and near Corunna were seen numerous indistinct impressions of plants, with small pieces of coal, retaining the ligniform structure, but perfectly carbonized. Loose pieces of coal are found quite universally in excavating around most of the counties bounding the coal formation; and on Grindstone creek there is found a bed, having an average thickness of eighteen inches, and not exceeding two feet at any point. It is expected that a canal will cross the coal formation at a point where there is reason to hope that beds of coal will be brought to light. In the carboniferous limestone underlying the coal, are found sulphate of strontia and sulphate of baryta, brown spar, hog-tooth spar, gypsum, &c. The red sandstone of the graywacke group rises at the pictured rocks on Lake Superior, in a mural precipice of two hundred to three hundred feet high. Gypsum appears above the surface, and probably exists in large masses in Kent county.

There are numerous salines and salt springs in Michigan, and a copious table is annexed, exhibiting their contents, and comparing them with those of salt waters in New York, Ohio and the Atlantic; it is obvious from this comparison, that the salines of Michigan may hereafter prove very valuable, but as yet they have been little developed. The temperature of the different springs was from 48° to 51° Fah.,* while that of fresh water in the vicinity was usually about 50°. In Michigan, as elsewhere in the west, the Indians were acquainted with the salines, and extracted the salt in a rude manner. The wild animals also found their way to these licks, (as they were called,) and their paths often gave the first information of the existence of the springs.

Nearly the whole western coast of the peninsula next to the lake, is bordered by a succession of sand dunes or hills of loose sand, not unfrequently attaining a considerable altitude, partly naked, and in part covered by dwarf pines and cedar, and should these be thoughtlessly removed, the sands might drift, and prove a serious evil.

Marls are common, especially in the northern parts of St. Joseph's, and the adjoining counties. Bog iron ore exists in vast quantities near Kalamazoo and Detroit, and other places. There are sulphureous springs in Monroe county; and near Havre there is a spring of this description, whose circumference is one hundred and fifty feet, its depth thirty five, and the stream is sufficiently copious to turn a mill.

Topographical maps of the several counties are in the course of preparation, and the geological survey will be prosecuted, we trust, with vigor and success.

In addition to Dr. Houghton, the corps consists of Ab'm. Sager, principal assistant in Zoology and Botany; S. W. Higgins, Topographer and Draftsman; Columbus C. Douglass, Sub-Assistant; Bela Hubbard, Sub-Assistant; William P. Smith, Sub-Assistant, in charge of Mechanical Zoology.

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* In one case, 46°.

*Indiana.*—Report, by David Dale Owen, M. D., Geologist of the State, 34 pages.

Divisions of the subject.—An introductory Address to the Legislature of Indiana—Leading principles of Geology—Plan of conducting the Survey—Summer Survey south of the national road—Fall Survey north of the national road—Remarks on the mineral deposits, soil and growth, peculiar to the different strata, south of the national road; north of the national road—Practical inferences—Appendix.

The survey, hitherto made, has been general, the object being to gain a clear and connected idea of the whole, before examining particular places, in detail. It was ascertained that the order of superposition of the strata was the same as in many other and distant parts of the western States, and that the characteristic fossils of each series of strata agree in a remarkable manner with those found in the corresponding strata throughout the western States.

Mr. Owen finds that the entire western portion of Indiana is rich in coal, which, as the forests are fast disappearing, must become of the greatest importance. This fact cannot fail to arrest the attention of the legislature, and of the people; and as a proof of the importance of geological knowledge, he cites the instance of an expensive, but fruitless, exploration for coal near Baltimore, in a situation where a well instructed geologist would never have looked for it, as the formation was too recent, and the substance discovered and mistaken for coal, was lignite. As evidence of the importance of correct geological knowledge, he justly cites other instances of the natural associations of minerals; for example, of the oxide of tin, with primary rocks, and its absence from more recent rocks. The dip of the strata in Indiana is such, being to the east, as to place the coal on the top of the formations towards the western part of the State, and down the Ohio; except the diluvium, it is the newest formation; while up the Ohio, or east, we constantly arrive at older and older strata.

Mr. Owen gives a clear statement of the sub-carboniferous rocks, among which he names a limestone, having an oolitic structure, "composed of egg-shaped grains, like the roe of fishes;" this is of course, geologically, a very different rock from the oolite of Europe, whose position is far above the coal formation. Next below, is a siliceo-calcareous rock, containing marine remains of the coralline family. Lower down, is a bituminous aluminous slate, sometimes mistaken for a part of the coal series, but no coal is ever found beneath it.

Still lower down, the rocks are very fossiliferous, and among these rocks is a good hydraulic lime. There is a very good burr stone, almost entirely made up of a series of fossil corallines, often cased in a sheath of drusy crystals of quartz. These burr stones have served well as mill stones. The lowest limestone beds are exceedingly rich in fossil shells and corallines; the rock is of a gray color, and when polished, forms a marble, adorned by the organic remains. Near Indianapolis, and the great national road in that vicinity, the rock formations are covered by diluvium, so thick that the deepest wells have not penetrated through it: the same is the fact on the north side of the national road.

It appears that bowlder stones of primitive rocks are numerous in Indiana, especially in the northern and prairie region of the State; they are called by the expressive name of lost rocks, also gray heads, and negro heads.

The northwest corner of Indiana is bounded by Lake Michigan, which in this part has for its bed a stiff tenacious clay, and still the water is so clear, that the fish, as in Lake George, can be seen, in calm weather, at a great depth. The southern boundary of the lake is composed of rolling ridges of siliceo-calcareous sand, and it is remarkable that this sand, taken from thirty or forty feet deep, will produce excellent potatoes, water-melons and pumpkins: wild rye, six feet in height, and rank grass, are said to have formerly grown at the top of the sand knobs, sixty or seventy feet high: the mixture of the lime with the sand accounts for this fertility. South of the national road, is found the compact hydrated brown oxide of iron, of good quality: some of it is in a conglomerate state, made up of fragments of the ore. There is also carbonate of iron.

At Troy is found a valuable material for pottery—the potters call it marl—Mr. Owen, clay slate (slaty clay? Ed.) It is hard when first dug, but crumbles on exposure to the air. This furnishes the raw material for the fire-brick, and saggers for a manufactory of queen's ware and porcelain; the clay for the latter is brought from the clay banks on the Mississippi, (erroneously called the chalk banks,) and near to the manufactory, there are good beds of potter's clay for the more common ware. Coal exists abundantly in the vicinity in several places, and some of it (on Deer creek, near Troy) is cannel coal. A party of forty potters from Staffordshire, under Mr. Clue, and a company formed in Louisville, have already begun this important manufacture of stone ware, and the first kiln was burning in June, 1837. Carbonic acid exists abundantly in the waters of this country; much iron and lime are held in solution by it, and again deposited as the carbonic acid evaporates, the former as bog iron, which in one place (Mishawakee) is fifty or sixty yards wide, and from seven inches to three feet deep, and so firm as to require an iron bar to raise it. The lime is deposited as tufa, and it is a curious fact, that, as the limestone rocks are buried deep under diluvium, and are therefore in a great measure inaccessible, the inhabitants resort to the calcareous tufa and calcareous bowlders, for materials to afford quick lime by burning.

Mr. Owen justly concludes that three geological formations exist in Indiana.

1. A bituminous coal formation, occupying that portion of the State west of the second principal meridian.

2. A limestone formation, (similar to the mountain limestone of European geologists,) prevailing in the counties east of that meridian.

3. A diluvium, consisting of deposits of clay, sand, gravel and bowlders, overlying, and in many places covering up, the two other formations, to a greater or less depth, particularly in the northern part of the State.

He infers on unanswerable grounds, that Indiana was long under an ocean, which furnished the innumerable marine organized bodies, found in such profusion enclosed in the solid rocks, especially the lower limestone.

There are some very judicious remarks on the useful materials found in the State, and on the nature of its soils, and the causes of their great fertility. This is attributed to the position of Indiana, near the middle of the great valley of North America, which has been the receptacle of a vast variety of the ruins of rocks, of many formations, thus affording the requisite materials for the best soil, among which lime, clay and sand, are conspicuous, with a portion of iron, and abundance of carbonated calcareous waters, and better materials could not be desired, especially for the growth of wheat, and of other grasses. The report is concluded with suggestions as to a future detailed survey, which, as they are (like the entire report) marked by much good sense and correct knowledge, ought to command, and we trust will secure, the attention of the legislature and people of Indiana.

*Ohio.*—First annual report on the Geological Survey of the State of Ohio, by W. W. Mather, principal Geologist, and the several assistants; 134 pages with a map and sections. Columbia.

The extent of this exploration and the diversity of objects which it has embraced, will be best understood from the divisions of the subject which we annex, made up from the contents and index; and the names of the gentlemen who acted as assistants, will appear in connexion with the contents of their several reports.

*Prof. Mather's Report.*—General considerations.—Coal, quantity, its practical value compared with Charcoal for furnaces, annual prospective consumption of it, means of motive power inexhaustible.—Iron Ore, extent.—Iron trade, reduction of iron ores. Limestones, extent and uses, marbles, galena and fossils.—Sandstones, importance for public works, uses and export.—Clays, uses for bricks, pottery, &c.—Peat, varieties and uses.—Soils, productiveness, texture, substrata, drainage, and composition.—Mineral manures, limestone, gypsum, marls and lime.—Mineral springs, salt springs, petroleum.—Alluvial action on the Muskingum and Ohio, on the Lake coast, at Fairport, Chagrin, Cleveland, &c.—Analysis of coal and ores, coal for smelting, manufacture of coke in Ohio, used in high furnaces.—Importances of determining the dip.

*Dr. Hildreth's Report.*—Introductory remarks, coal fields of Great Britain, extent of coal in Ohio.—Rock strata above the buhrstone.—Buhr-stone, range and extent, value and importance, quality and character, French buhr compared with the Ohio buhr, mineral contents of the calcareo-silicious rock, agricultural character of the Buhr-stone region, iron ore with the buhr-stone, strata between the buhr and upper fossiliferous limestone.—Upper fossiliferous limestone, range and extent.—Strata between the limestone and Pomeroy coal beds.—Pomeroy coal beds, range and extent, fossils which accompany them, agricultural character of the region.—Strata between the Pomeroy coal and limestone coal.—Limestone coal, range and extent.—Limerock, non-fossiliferous.—Stone marls, range and extent of lime and marls, agricultural character of the region.—Fossil fresh water shells, fossil contents of red shales.—Upper bed of coal.—Coarse sandrock and conglomerate, their grottoes and caverns.—Upper series of sandrocks.—Salt springs and their early history, salt manufacture, remarks on the salt producing rocks.—Quartz or calcareo-silicious rock.—The Scioto salines, early legislation on the Ohio salines, Muskingum salines, Gallipolis salines, leading creek salines, Hocking valley saline, Muskingum valley saline.—Number of salt wells and manufacture.—Petroleum and carb. hydrogen gas.

*Prof. Kirtland's Report.*—Introductory remarks.—Advantages of the survey and from the study of botany.—Economical importance of zoological knowledge.—Coloring materials from vegetables.—Importance of our native plants.

*Prof. Briggs's Report.*—Reconnaissance of country between the Scioto and Hocking rivers.—Geological sections.—Aspect of the country.—Importance of the hilly character of the country.—Mineral deposits and dip, mode of determining the dip.—Groups or sub-divisions of rocks.—Limestone district, uses for marbles, building, &c.—Slate described by Mr. Foster, minerals in the slate, alum, copperas, gypsum, &c., mineral springs and bog-iron.—Waverly sandstone series.—Conglomerate.—Lower coal formation, sandstone, shales, limestone.—Coal of Hocking valley, Jackson, and adjoining counties, its quality in the lower series, between Scioto and Hocking.—Iron ore, furnaces of Scioto and Lawrence, construction of furnaces, roasting and smelting ore, iron ore of Jackson county, prospective iron manufacture, lead and zinc ores, salt wells, their geological position.—Fossil bones.

*Col. Whittlesey's Report.*—Original surveys, highways, character of the country, Ohio and Scioto rivers, streams, Jackson county, salt springs, timber, ancient works, change of names, Virginia military reservation, untaxed lands, military bounty lands. Western reserve, unsurveyed shore, geological queries, glossary of geological terms.

As in the case of Pennsylvania, the very extent and variety of the research, almost preclude the attempt to give even a general notice of the principal facts, and if we seem to give greater prominence to the newer states, it is because they are less known, and also because copious details concerning the geology of Pennsylvania and Ohio, have been already given, in former volumes of this work; of the coal and salines of Ohio, by Dr. Hildreth, and of the coal in two principal districts of Pennsylvania, by the Editor of this Journal, and the Rev. George Jones. Our limits, also, warn us to be brief, and we may expect a better consummation from the gentlemen themselves, when their labor is accomplished.

We have also another reason for brevity in the case of the Ohio report; for just as this number of the Journal is about closing, we have received an analysis and review of that report—too long and too late for the present number, but which will appear in our next.

If we have any thing to add to the review, we shall not therefore anticipate it now. In concluding, we have only to say, that both Pennsylvania and Ohio, are states whose territories are stored in abundance with the principal substances most necessary to man; coal in its most important varieties, salt, limestone, iron ore and many other things. Ohio, is eminently a vast region of organic remains, and even its human antiquities, arrest the attention of the geologist as well as of the antiquary. Both States are in the course of survey by very able men, but we are extremely sorry to see that Dr. Hildreth, who worked early and almost alone—who worked hard, and who worked well, has withdrawn from the survey, and we are still more sorry to observe that ill health is the cause; for his country's sake and his own, may he soon be well again!

Dr. Locke, by reason of absence in Europe, did not perform the duty assigned to him.

By a letter from Columbus, we regret to learn, that the survey is just suspended, and party grounds are assigned as the cause! On such a subject, there should be but one party. The noble State of Ohio, must and will vindicate her honor and her interest by resuming and finishing this great work, so ably begun and carried forward with so much spirit and success!

3. *Fossil Fishes.*—It is very generally known at the present day, that fossil fishes abound in the sandstone formation of the Connecticut river valley. As the study of these fossils, in connection with the rocks in which they are imbedded, has become a science of daily increasing interest and importance, it seems desirable that every one should contribute what local and practical information he may possess, in aid of this important object.

Prof. Hitchcock has particularly described localities in several towns of Massachusetts; but, so far as I know, he has only occasionally alluded in general terms to the occurrence of ichthyolites at Middletown, Ct. One of the earlier numbers of this Journal contains a brief account of some specimens procured at Westfield, the western parish of Middletown, from a pit excavated some years ago, with the delusive expectation of finding coal. But the notice states that they were taken up many feet below the surface, and in such a situation as would render it impossible to obtain more, unless the mining operations should be resumed. Fortunately for science, a much more favorable locality has since been opened in the vicinity, from which the fish impressions may be obtained in almost any quantity, with but little exertion. Fossils of the same kind are also procured in Middlefield, the adjoining parish, at a locality which has been known for several years.

Having in the past year visited both these places repeatedly, I submit the following remarks, which may be interesting to geologists.

The Westfield locality is situated about three quarters of a mile in a north direction from the Congregational church, in the bed of a small stream, which becomes nearly dry in the autumnal months,—the most favorable season for procuring the fossils. The operations of previous explorers are observable for several rods down the stream; but the peculiar site which seems to afford specimens the best defined, in the greatest abundance, and with the least labor, is just west of a large spring, in the channel of the brook. The impressions found here are usually so indistinct as to render it difficult to recognize the minute characters by which species are usually distinguished. In a paper recently read before the Lyceum of Natural History of New York, Mr. J. H. Redfield has offered names for two varieties, common to this place and Middlefield: one of these he calls *Catopterus gracilis*, and the other, *Palæoniscus latus.* Without doubt, other species, if not genera, will hereafter be recognized. A single individual, of extraordinary size, which it seems difficult to refer to either of the above genera, was obtained here last season, and is now in possession of Mr. Jennings, a young gentleman of the Wesleyan University. The rays and scales are not sufficiently well defined to admit of a correct and precise description. The following are some of the dimensions, as found by accurate measurement, viz. Breadth of caudal fin, 3½ inches; length of anal fin, 3½; length of dorsal fin, 2½; greatest breadth of body, 4 inches; least do. 1¾ inches. The head and anterior portion of the body are wanting, the specimen being broken off near the base of the dorsal. Probably the whole length was not less than 16 inches. The stone in which the fishes occur, is a hard and brittle slate, or bituminous shale, interstratified with sandstone, and bearing some traces of vegetables converted into coal. A few indistinct specimens of a fossil, bearing a strong resemblance to the eel, have recently been discovered; but perhaps they will be referred to the family of flags. Visitors will find it necessary to obtain permission of the female proprietor.

The Ichthyolites of Middlefield are found on land of Mr. George Miller, at a spot locally known by the name of "Saw-Mill Hollow," near the Durham line, about four miles S. S. W. from the city of Middletown. The strata of slate bearing the impressions, have a thickness of six or eight inches, and are situated near the bottom of a narrow ravine, excavated by a small stream which falls over the ledges, and affords a beautiful piece of scenery. Specimens are not so easily procured here as at Westfield, but they are far more perfect, both in vividness of color and distinctness of impression. The most delicate parts of the fins and scales are almost invariably preserved. It is very rarely that any vestige of bones is met with in that part of the body covered by scales; but traces of them about the head are not uncommon. It is no unusual thing to find impressions perfect in every part, with the exception of a fin, or a portion of the tail, or a narrow strip along one side of the body, which are sometimes seen lying at the distance of two or three inches, and sometimes are removed by greater intervals. Not unfrequently the fish appears to have been entirely decomposed previous to its becoming fixed in its stony bed, so that the rays and scales are scattered in all directions over a space of one or two square feet, no two of the scales, perhaps, being observed in connection. The slate, upon which the impressions are found, is very strongly impregnated with bitumen, and occasionally presents thin layers of calcareous spar. It occurs in every variety of texture, from the finest clay up to the coarsest conglomerate; though no ichthyolites are seen except on three or four of the darkest colored and most delicate layers. Below the fish strata, as well as above, the slate, well characterized, is several feet in thickness; after which, it passes gradually into sandstone.

The erroneous opinion, somewhat extensively circulated, of this locality being exhausted, probably arose from the difficulty experienced in excavating the rock, which, owing to its peculiar position, is not so easily quarried as that of Westfield. But if visitors go adequately prepared, and with a proper guide, and commence operations on a scale sufficiently extensive, little difficulty will be experienced. The most proper course to be pursued is, to pry out the rocks which have been loosened by the ice of the preceding winter. Blasting will be of no use, as the slates are thereby shattered in pieces, and they do not separate in layers till after the frost has acted upon them. The proprietor of this locality is one of those enlightened and enterprising farmers, whose leisure moments have been devoted to reading, study, and meditation upon scientific subjects. He takes great pleasure in assisting strangers who may visit the place, and is ready at all times to communicate any desired information.

I have obtained as many as five species from Middlefield. Whether they have as yet been named, with the exception of the two varieties mentioned above, is somewhat uncertain, owing to the rarity of works which treat of fossil ichthyology. If they have not, I wait for other and more experienced collectors to describe and classify them. D. L. H.

Central Village, Ct., March 15, 1833.

4. *Fossil Fishes in Virginia; from* William C. Redfield.—William Kemble, Esq., of this city, has kindly placed in my hands a fragment of shale containing beautiful impressions of fishes, of which portions of twenty individuals can be made out on one side of the fragment, the size of which does not exceed twelve by eight inches. It was brought to this city by Mr. George B. Cook, from the Virginia coal region, thirteen miles west of Richmond, and was obtained a few days since, about two hundred feet below the surface, and beneath one hundred and eighty feet of rock, in a new shaft which is excavating in quest of coal. All the impressions appear to belong to a single species, are four or five inches in length, and nearly resemble the *Catopterus gracilis* described in the fourth volume of the Annals of the New York Lyceum of Natural History.

New York, April 6, 1838.

5. *Analysis of the scales of the fossil Gavial of Caen, in Normandy;* by A. Connell, Esq., F. R. S. E., &c., in the Ed. New Phil. Jour. No. 46.

Mr. Connell found the constituents of the Caen scales to be as follows:

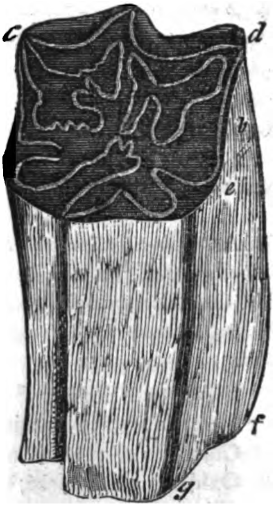
| | |
|---|---|
| Phosphate of lime, with a little fluoride of calcium, | 78.59 |
| Carbonate of lime, - - - - | 12.53 |
| Sulphate of lime, - - - - | 1.96 |
| Phosphate of magnesia, - - - | .11 |
| Chlorides of potassium and sodium, - - | .74 |
| Oxide of manganese, - - - - - | .45 |
| Siliceous matter, - - - - - | .37 |
| Water, - - - - - - | 5.07 |
| | 99.82 |

The author, from the above analysis, concludes that these scales were originally of the nature of bone, and in all probability analogous to the osseous scales of fishes; and hence the presence or absence of bone-earth in such fossil relics can be of no service in determining whether they had belonged to saurian animals or to fishes, as he at one time, from the usua views of chemists respecting the nature of recent saurian scales, had thought might have been the case.

6. *Interesting Fossils found in Louisiana.*—The following is an extract of a letter to the Editor, from W. M. Carpenter, A. M., M. D., dated Jackson, La., Feb. 6, 1838. The fossils herein described were found in the parish of West Feliciana, about 25 miles from this place, on a small stream which is called Little Bayou Sara, in a part of the country whose geology is different from the greater part of Louisiana, in not belonging to the delta formation. This formation runs from the lower part of Alabama across the lower part of Mississippi westward, until it strikes Lake Ponchartrain, continues around the eastern shores of this lake, and

then N. E., until it strikes the Mississippi river at Baton Rouge. It then continues on the eastern side of this river up to Vicksburg, forming the steep bluffs on the eastern side; it then crosses the river, and extending across the country, strikes the Red river at Alexandria; from thence it passes down southward, its eastern boundary being almost exactly parallel with the Bayou Bœuf, lying altogether W. of this river, and continuing on to the sea, but inclining more to the westward after it reaches the parish of Attakapas. This is the formation over which the prairies are found. It consists first of clay, composed of aluminous clay and sand in various proportions, sometimes almost without grit; next of a layer of rolled pebbles; then a layer of sand; then a layer of aluminous clay, varied red and white, sometimes in nodules of irregular form; then quicksand; and then a similar layer of variegated aluminous clay. The fossils generally found are not *in situ*, but are confined to the rolled pebbles, which contain impressions of shells, encrinites, and asterias; they are (no doubt) quartz replacements of lime.

Fig. 1.



The fossils above alluded to were found in the first layer, beneath the vegetable mould, that is, in the sandy clay. They were—First: a mastodon's molar tooth, corresponding exactly with that figured in Cuvier's Ossemens Fossiles, third edition, Vol. I, Plate 1st for Mastodon, Fig. 1. This tooth weighs 6½ pounds. Second: a part of the right lower jaw, containing two teeth of the mastodon, but evidently a very young animal, as they were not at all worn; the whole weighs eight pounds. These teeth have only three ridges transverse. These were found about a mile apart. Thirdly: a molar, somewhat similar to the first, but much larger, and the transverse ridges of the crown, which were four, are worn down almost smooth; weighs 12 pounds. Fourthly: a tooth which was found with this last, (about two miles from the two first.) It is the third molar of the upper right jaw of a horse. A drawing of the crown, and oblique view of two sides, is given at Fig. 1; the outer side of the tooth is shown at Fig. 2; the front side at Fig. 3.

There are some slight deviations from the common forms of the festoons of the enamel upon the crown; but differences frequently are found in the forms of these in living horses. From *c* to *d*, (Fig. 1.) measures an inch and a quarter; from *d* to *f*, (Figs. 1 and 3.) it measures 3½ inches, though all of the hollow or shelly parts of the roots are gone, which in common horses measure ¾ of an inch. This would make the original length of the tooth more than four inches. The size of the tooth in other directions was about proportional. Now as these measurements go far over those for our largest horses, they would seem to indicate a fossil horse larger than those of the present epoch; whereas Cuvier says that all the bones of horses seen by him, indicated the former existence of small horses. (*Ossemens Fossiles*, 3d edition, Vol. II. pp. 112, 113.) This fossil is rendered interesting, as the remains of the horse are but seldom found fossil in America.

Fig. 2.

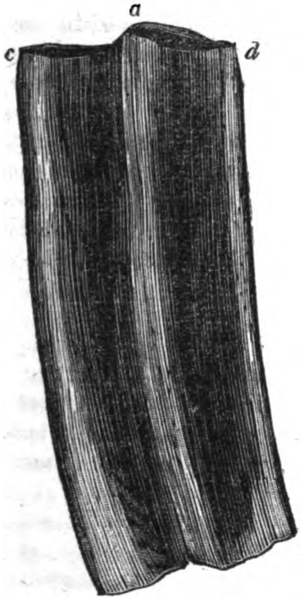
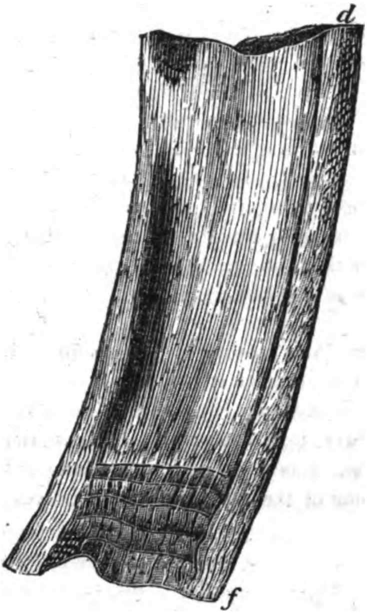


Fig. 3.



The enamel of all these teeth is in a good state of preservation; the internal or bony parts have a peculiar ferruginous color, a little deeper than that of the sandy clay in which they were found; they are very fragile. The large mastodon's tooth and that of the horse were found immediately together, at a considerable depth (several feet) beneath the original surface.

These fossils came from a neighborhood which seems to abound in those of the mastodon. A molar was found about six or seven miles from the same place, several years since, weighing 13 pounds. It was sent to England by the person who obtained it.

Those lately found are in my charge, deposited in the cabinet of the College of Louisiana.

7. *Sienitic Granite, near Christiana, Norway.*—An eminent English geologist, who has recently visited this famous granite, states, that "it occupies a mountainous country, and has (geologically considered) the true granite character, and that Von Buch was quite right in affirming that all of it is decidedly newer than the shales and limestones containing trilobites and orthoceræ, &c.; that it sends off veins into this transition formation, and hardens and alters it for a considerable distance, without deranging its strike or dip; yet this same granite, so decidedly newer than the Siberian strata of Norway, passes sometimes into gneiss, and in other places sends veins into gneiss; yet this gneiss is much older than the fossiliferous transition strata, having been disturbed in its stratification and greatly denuded before the fossiliferous beds were deposited unconformably upon it. I never had an opportunity before," remarks the observer, "of seeing a perfect gradation into each other of these two crystalline rocks, in a country where they can be proved to be so extremely distinct in age. How often may other masses of granite be newer than we suspect, where no similar evidence is at hand to establish their chronological relations?" It can no longer be doubted that granite has been occasionally thrown up in all geological ages not more recent than chalk, and therefore granite may be not only the most ancient rock, but also one of the newest.

8. *New locality of Tourmaline.*—Brown tourmaline was found by us last September at the steatite quarry near Orford, N. H., of great size and perfection. It is firmly imbedded in the steatite of certain portions of the quarry, to the great annoyance of the workmen; and owing to its brittleness, it is somewhat difficult to extricate it unbroken from its matrix. Some of the crystalline faces are curiously modified.

## GENERAL PHYSICS AND CHEMISTRY.

1. *Notice of a splendid Aurora of* 1789—communicated by the Rev. Prof. Henry Ware, D. D., &c. of the University of Cambridge, Mass.—On the evening of Saturday, Nov. 14, 1789, at Hingham, Mass., was exhibited the most remarkable Aurora Borealis that I ever witnessed. It first attracted my notice at about seven o'clock; and from that time till eleven,—and I know not how much longer,—was exhibited a constant succession of rapid and surprising changes in shape, color, extent and motion.

At about ten o'clock a large portion of the northwestern quarter of the hemisphere was covered for a considerable length of time, with a dark uniform blood color,—continually, but by a slow and graceful motion, varying in its shape and extent; at the same time that the exhibition of various hues was continued in the north and east. At about half past ten, there burst out in the southeast, at the elevation I should think of about 45°, a light of dazzling splendor, which rapidly spread itself around in all directions, becoming less distinct, as it was further diffused. At first the brightness was too intense for the eye; and after it had lost much of its brilliancy by its diffusion, it was still such as to enable me to read the finest print by its light with great ease. It continued to spread around in every direction, until the whole hemisphere was covered, and a beautiful crown was formed in the zenith, exhibiting all the colors of the rain-bow. The bursting forth of the brightness in the southeast was instantaneous, and of about the apparent size of the moon. It was as if the blue concave had been pierced through by a cannon ball, and torrents of liquid silver at a white heat had rushed through the aperture, rolling along in waves on the inside of the shell,—gradually cooling as it spread, changing its color, and becoming fixed.

2. *Transmission of Galvanic light through metals of different conducting powers;* by James Thomas.—On the occasion of trying some experiments with the galvanic battery, previous to an exhibition of them before the Mechanics' Institute, I wished to repeat Mr. Children's experiments, relative to the transmission of the electric current through wires of different conducting powers; for this purpose I formed a chain of silver and platinum wire in alternate links, and also one composed of copper and platinum, following the directions given by Mr. Brande.*

"Select some fine silver and platinum wire and cut it into lengths of about two inches; then form a continuous wire by joining these lengths endways in alternate order, and suspend it in the form of a festoon, between two thick copper wires, forming the poles of the battery, having previously temporarily united these poles by a thick copper wire; on removing the latter, the electricity traverses the compound wire, and occasions the ignition of the platinum portions of it, the silver being unaffected. The object of uniting the poles by a thick copper wire, whilst the compound wire is being attached, is to prevent the sudden fusion of the latter at the point of contact, which often happens when this precaution is not taken."

"Platinum and gold being thus connected and introduced into the electric circut, the platinum was instantly made red hot, whilst the gold remained unaffected. With a similar arrangement of gold and silver wires the gold was ignited; the silver not. With alternations of platinum and silver all the platinum wires were ignited, but none of the silver."

On trying the experiment with a chain of this description, the battery when in action was incapable of producing ignition, to any extent, in the platinum portions of the wire, and I had greatly to reduce its length before the experiment would succeed. Indeed so little satisfactory did the experiment appear to be, that I was going to substitute in its place, that of shewing the ignition of a plain piece of platinum wire; when recollecting that whenever the poles of a battery in action come in contact, or the contact is broken, a spark is given out; I thought that if the contacts of the alternate links could be broken, or even a little disturbed, they would shew the electric spark at the points of contact.

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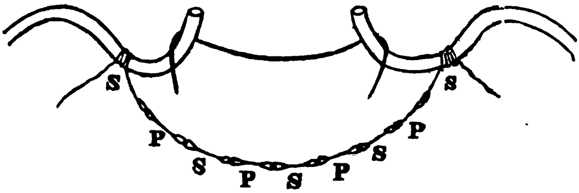
* Manual, fourth edition, page 271.

To try if this was correct, I rejoined the links of the chain of platinum and silver wire, making it about one and a half or two feet long. Each end was silver wire, to attach it to the poles of the battery. The battery being in action, and its poles connected by a copper wire; the chain was suspended from the poles in a festoon. The copper wire being removed, on giving the festoon a short irregular motion, by striking it on the under or convex side, with a splint of wood, a succession of sparks was produced, of a brilliant and imposing appearance. This will continue, the battery being in action, as long as the proper motion is given to the chain. This motion can be so managed, as to give out sparks in a slow or a rapid manner.

This experiment was repeated in the evening before the members of the Institute; and the lights being nearly extinguished, it shewed the experiment to better advantage than by day light. The battery that was used is the one belonging to the Institute, of about 200 double plates; I believe you have used it, on one occasion or more, when in this city.

Will you be kind enough to repeat this experiment, if not interfering with your arrangements.



*Note.*—It is found better to use the copper wire bent as in the above, than to twist it around the poles, as it could be detached without trouble, or danger of receiving shocks.

3. *On a new pyrogenic acid*, by M. S. Baup.—M. Baup has discovered that, independently of a spirituous liquid and a bituminous oil, pyrocitric acid is not the only product of the distillation of citric acid, but in addition a second acid is formed which hitherto has not been remarked. It is obtained by evaporating the liquid resulting from the distillation of citric acid, until small acicular crystals are observed; when these crystals are to be separated preparatory to obtaining the new

acid, which is easily isolated from the first by successive solutions and crystallizations, on account of their very different solubility. M. Baup names this acid *citricic*, reserving *citribic* for the pyrocitric acid of Lassaigne.

It is inodorous, and possesses a strongly acid taste. Its crystals are rhomboidal octahedrons, and its primitive form the right rhomboidal prism. At 10° C. it is soluble in 17 parts of water; at 20° in 12 parts. Its solubility augments with the temperature. At 15° it dissolves in four parts of alcohol at 0.88; it is also soluble in ether. A heat of 100° or even 120° C. separates no water of crystallization. At 161° C. it is a colorless liquid which crystallizes on cooling. In the crystalline state it may be represented by formula $C^{10} H^6 O^4$. When it combines with bases it loses one atom of water and becomes $C^{10} H^4 O^3$. This acid is therefore isomeric with that of the citribic acid of Dumas.

Citricic acid precipitates the acetates and subacetates of lead, and communicates a reddish tint to the ferric salts. The citricates of potash and soda are very deliquescent. In the neutral citricates as well as citribates the oxygen of the base equals one third that of the acid.—*L'Institut, No. 167.*

4. *On the non-existence of a compound of Platinum and Hydrogen*, by M. Döbereiner.—According to Berzelius, the black non-metallic substance obtained by precipitating a compound of chlorid of platinum and iron, and afterwards reducing by means of hydrogen gas, is a compound of hydrogen and platinum. Davy also supposed that a compound of these two elements was formed by throwing an alloy of platinum and potassium into water, by which the potassium was separated into black scales.

Döbereiner has studied both these compounds with care, and finds that they present the same action with hydrogen, (that is, they become red,) as the compounds obtained in the moist way by means of alcohol, sugar, or formic acid. Moreover, they oxidize formic and oxalic acids, producing at the time carbonic acid, and acetify alcohol. His experiments therefore demonstrate that all these properties proceed from oxygen gas, which is mechanically condensed in this preparation of platinum, on account of the strong affinity of powdered platinum for oxygen.—*Ann. der Phys. und Ch.* 1835, *No.* 10.—*L'Institut, No.* 161.

5. *Sixth satellite of Saturn.*—By a letter from Sir J. Herschel, from the Cape of Good Hope, dated June 12, 1837, to a gentleman in London, it appears that he has rediscovered the sixth satellite of Saturn, (the second in order of the seven from the planet.) Since his father's observation no one had been able to procure any decisive evidence of its existence, farther than by his report. Sir J. H. had several good observations of it, and has traced it round and round many revolutions.—*Editor's correspondence.*

### 6. *Meteorological Register for 1836, kept at Montreal, Lower Canada, in Lat. 45° 30′ N., Long. 73° 22′ W., by J. S. M'Cord, Corresponding Secretary, Natural History Society.*

| Months. | Barometer. | Thermometer. | WIND. | | | | | | | | WEATHER. | | | | | | Rain Gage. | Snow Gage un-melted.‖ | Temperature of the bottom of the Well at Guilbault's Botanic Garden, thirty one feet deep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of days blowing. | | | | | | | | Number of days of each. | | | | | | | | |
| | | | N. | N. E. | E. | S. E. | S. | S. W. | W. | N. W. | Cr. | Cy. | Rn. | Shrs. | Fog. | Sn. | | | |
| JANUARY, . . . . . | 29.946 | 17.05 | 7.00 | 4.50 | 0.50 | . . | 3.00 | 3.50 | 7.50 | 5.00 | 10.00 | 13.25 | 0.50 | . . | . . | 7.25 | . . | 18.20 | 43 |
| FEBRUARY, . . . . . | 29.965 | 11.32 | 5.50 | 1.00 | . . | . . | 1.50 | 6.50 | 9.50 | 5.00 | 12.25 | 10.75 | 1.75 | *1.75 | 0.25 | 2.25 | . . | 19.35 | 43 |
| MARCH, . . . . . | 29.907 | 20.90 | 5.00 | 1.34 | . . | 1.16 | 6.50 | 7.84 | 7.66 | 1.50 | 14.25 | 12.50 | 1.00 | . . | . . | 3.25 | . . | 14.40 | 41 |
| APRIL, . . . . . | 29.959 | 35.24 | 8.33 | 3.34 | 0.84 | 0.33 | 5.83 | 4.50 | 2.50 | 4.33 | 17.25 | 7.50 | 1.75 | 0.25 | †0.25 | 3.00 | 0.50 | 8.45 | 41 |
| MAY, . . . . . | 29.870 | 53.32 | 9.34 | 1.50 | 1.58 | 0.50 | 0.83 | 4.50 | 4.75 | 1.00 | 9.50 | 8.75 | 5.00 | 0.75 | ‡. . | . . | 3.70 | 0.50 | 41.5 |
| JUNE, . . . . . | 29.934 | 65.25 | 4.00 | 4.00 | 4.00 | 3.50 | 8.00 | 3.00 | 2.50 | 1.00 | 14.75 | 9.50 | 2.50 | 2.75 | 0.50 | . . | 1.25 | . . | 45 |
| JULY, . . . . . | 29.859 | 71.90 | 7.84 | 1.50 | 1.00 | . . | 4.50 | 9.33 | 4.50 | 2.33 | 19.50 | 7.00 | 2.25 | 2.25 | . . | . . | 2.70 | . . | 50 |
| AUGUST, . . . . . | 29.872 | 63.05 | 4.00 | 0.50 | 2.00 | 0.50 | 6.00 | 7.00 | 5.50 | 3.50 | 14.75 | 8.25 | 4.50 | 1.50 | §. . | . . | 2.95 | . . | 53 |
| SEPTEMBER, . . . . . | 29.917 | 57.46 | 5.84 | 1.33 | 1.50 | 1.83 | 4.50 | 6.50 | 6.00 | 2.50 | 15.75 | 9.00 | 4.25 | .75 | . . | 0.25 | 2.05 | . . | 52.5 |
| OCTOBER, . . . . . | 29.989 | 39.37 | 1.00 | 3.00 | . . | .50 | 4.50 | 8.00 | 10.50 | 3.50 | 10.50 | 14.25 | 4.25 | . . | . . | 2.00 | 3.55 | . . | 51.5 |
| NOVEMBER, . . . . . | 29.869 | 32.24 | 5.50 | . . | 1.00 | .50 | 4.50 | 5.00 | 8.50 | 5.00 | 6.75 | 18.25 | 3.00 | . . | . . | 2.00 | 2.50 | 5.15 | 46 |
| DECEMBER, . . . . . | 29.956 | 18.09 | 2.50 | 3.00 | . . | . . | 6.00 | 7.00 | 9.50 | 3.00 | 6.25 | 15.75 | 3.25 | . . | . . | 5.75 | . . | 11.60 | 43 |
| | 29.920 | 40.43 | | | | | | | | | | | | | | | 19.20 | 77.65 | 45.87 |

* Drifting. † Hail. ‡ Only 24 days of this month were recorded. § Only 29 days of this month were recorded.

‖ The Snow Gage is kept at Long Point, five miles from Montreal, by W. Belin, Esq., M. D.

| | |
|---|---|
| Mean pressure of the year, corrected and reduced to 32° Fahrenheit, - - - - - - - | 29.920 |
| Mean temperature of the year, being the mean of the maxima and minima taken by register thermometers, - - - - - - - - | 40.43 |

| | | |
|---|---|---|
| Maximum height of the barometer during the year, - | 30.550, | (24th December, 9 P. M.) |
| Minimum, - - | 29.000, | (14th December, 9 A. M.) |
| Range of barometer, - | 1.550 | |

| | | |
|---|---|---|
| Warmest day, (9th July,) | 90° | (mean of the 24 hours, 79.75.) |
| Coldest day, (2d February,) | – 19 | |
| Range of thermometer, | 109 | |

| | |
|---|---|
| Number of days of westerly winds, - - - | 189.24 |
| " " easterly " - - - | 46.25 |
| " " north " - - - | 65.85 |
| " " south " - - - | 55.66 |
| Number of days observed, - - | 357.00 |

N. B. The instruments used are all of the first description. The barometer, a standard mountain, by Newman. The register thermometers by the same, and compared with a standard by Adie & Son, Edinburgh. The rain gage by Newman, after the one used by the Royal Society, London. Every precaution is used in the placing of the instruments, which a residence in a city will admit of.

7. *Oil of the Tutui or Candle Nut Tree.*—From Mr. French of Honolulu, through the Rev. John Diell, Seaman's Chaplain, we received in August 1835, a bottle of the oil named above. Mr. French at that time had a mill and press, employed several native hands, and manufactured from one hundred to one hundred and fifty barrels annually. Mr. Diell remarks that "it is found when dried to answer an excellent purpose for paint oil, and that it might be manufactured to any extent, as the trees are found in abundance upon all the islands. The greatest difficulty appears to be in drying it properly—for if it is not boiled very carefully, and to just such a point, it never dries."

We are not informed whether varnish has been mixed with it, and whether boiled upon litharge, as is common with flax seed oil.

8. *Aerolites.*—An account has been received from Brazil, of the appearance of a meteor of extraordinary brightness, and as large as the balloons used by aëronauts. It was seen for more than sixty leagues in the

province of Ceara, and over the village of Macao, at the entrance of the Rio Assu; it burst with a noise like thunder, and an immense quantity of stones fell from it, in a line extending more than ten leagues. The largest portion fell at the entrance of the river, and in various places they pierced through several dwellings, and buried themselves several feet deep in the sand. No human life was lost, but many oxen were killed, and others severely hurt. The weight of those taken out of the sand varied from one to eighty pounds.—*The Athenæum*, (London,) Dec. 16, 1837, p. 915.

9. *New Magnetical discoveries.*—We have been favored with an opportunity of inspecting some proof sheets of a work by Dr. Henry Hall Sherwood, of New York, which will shortly be published, containing discoveries in magnetism of a very extraordinary kind, and probably of great importance. They include apparently unexceptionable demonstrations of the latitude, longitude, rate of motion, and periodical revolution of the magnetic poles, or "vortices" of magnetism, round the terrestrial poles; of the angles of the magnetic with the terrestrial meridians in every part of the earth, at any given time; together with a universal method of determining latitude, longitude, and variation, under all possible circumstances, by the dipping needle alone. The perfect regularity of the lines of no variation, and the value of their angles with the terrestrial axis in every parallel of latitude, also seem to be demonstrated; and this, in connection with the relative position of the nodes of the magnetic with the terrestrial equator, which is found with the utmost facility and precision, forms the basis of calculations for determining the past, present, and future variation of the compass needle, at any given place on the globe. These calculations are tested by numerous observations made in various countries, and the agreement is most strikingly exact in all the examples adduced.

One of the most interesting facts seemingly established in this work, is that the magnetic poles revolve in the latitude of the arctic and ant-arctic circles, or 23° 28′ from the terrestrial poles; and this coincidence is ascribed to the solar origin of these magnetic vortices, and to the correlative fact that the inclination of the earth's axis to the plane of the ecliptic is 23° 28′. In short, these discoveries, (here only partially and cursorily mentioned,) sustained as they are by extremely simple calculations, which evidently harmonize with all the recorded and original observations to which they have been applied, seem to warrant the expectation that terrestrial magnetism, at least, will soon be rescued from its present state of uncertainty and confusion, and elevated to a distinguished station among the exact sciences. We await the publication of Dr. Sherwood's work with an unusual degree of interest.—*Communicated.*

## BIBLIOGRAPHY.

1. *This Journal.—Notice forwarded to the Editor from a distant city in the South.*—Remark: Were not this Journal principally the production of others, it might appear improper for the editor to publish the following communication, which was wholly unlooked for. The writer, who is not a New England man, is a gentleman well and advantageously known in the literary world, and of a profession in no way connected with the direct cultivation of the sciences which the Journal sustains.

It is his particular request that the notice may appear, and we know not that we are precluded by considerations of delicacy. The writer of the notice possesses a complete copy of the Journal in all its volumes.—Editor.—*April* 3, 1838.

*To the Editor,—Dear Sir,*—Having some leisure, in the evenings, during the past year, I took up the American Journal of Science for reading, and I soon found it such an interesting and valuable companion that I read it through *in course,* omitting the articles on mathematics, and occasionally on some other branches. Praise would be out of place here, as I am addressing this note through the Editor himself; but I can, at least, say to you that we owe you a debt of gratitude for having persevered as you have done for twenty years, with this valuable publication. But gratitude alone, though I believe it is widely felt, is a poor recompense for such labors as these. The Journal of Science ought to be extensively taken throughout our country. This publication is as large as most of our own "quarterly reviews," and has a great number of expensive plates, and not a little difficult composition, and yet the price per annum is only a dollar more than other quarterly journals of popular literature. When bound, it makes a handsome and creditable addition to any library: and a more valuable mass of matter than its 33 or 34 volumes contains, I have never met with in the same number of pages. A great portion of it is readable, or may easily be made so, in a family circle, and certainly it would be a more profitable kind of reading than is often selected for such occasions. To scientific men, or to one who like myself is only a lagging inquirer in the ways of science, it is truly useful not only as condensing a valuable portion of the successful scientific labors of other countries, but also as affording a clear exhibition of much that is doing in our own; and to our adventurers in the scrutiny into nature, it is a happy and valuable stimulus as well as guide and assistant.

What a change has occurred in our country, since a few individuals, who were then the solitary collectors of minerals, could find no one even to give their specimens names. Now almost every principal town (not to mention smaller ones,) has its Lyceum with a good cabinet: private cabinets are to be met with every where; and many of the states have sent forth their public geologists to explore their territories and to search out the concealed wealth, that richly repays them for the expense. We have to thank you and your Journal for a large part of this rapid improvement: and it is a poor compliment for the intrinsic merit of your publication, for the public spirit which you have shown in persevering amid many discouragements, and for the aid and stimulus which you have afforded to scientific research in our land, and what I have to suggest is this. Nearly all the colleges in our country, I presume already take the Journal: every one ought to have a complete set, for it affords us a good exhibition of many of the most important facts attending the advancement of science in our country, and independent of its present utility, its value in years to come will be very great from this consideration alone. City and town lyceums ought also to possess the Journal of Science. They can well afford the expense and they will hardly find such a condensed mass of valuable matter any where else. We should encourage it as a book for reading in our families: the mind will be informed and the taste improved. Much of it would be intelligible, at the outset; and by conversation and a little study we could easily make more of it so, even to families. If it is too expensive for individual subscription, two or three gentlemen might easily unite, and in this way a number of *good* subscribers might be procured in every town. Lastly and especially, let those who take it, be punctual in paying for it.

A more valuable publication, I am satisfied, cannot be found in the whole range of periodicals in our land. With sincere respect,

Your friend and servant, H. L. P.

2. *Prof. Agassiz' Great Work on Fossil Fishes.**—We are happy to learn, by a letter dated Nov. 12, 1837, from this distinguished and indefatigable naturalist, that he had then very recently published the 8th and 9th livraisons of his magnificent work. We are thus assured that it is going forward towards, we trust, a happy completion, and that the rumor of its discontinuance was unfounded. Prof. Agassiz speaks in terms of warm commendation of the labors of Mr. Redfield, Jr., on the fossil fishes of Durham, Ct., &c., as they appear in a memoir presented last winter to the Lyceum of Natural History of New York, with drawings. M. Agassiz remarks, that these fossil fishes are described and determined by Mr. Redfield "with rare talent, and that it is much to be desired for the interest of science, that this expert (habile) naturalist should continue his researches, which appear to be destined to throw, at a future day, great light upon the geological relations of America and Europe."

3. *Prof. Agassiz on the Echinodermata.*—We are informed by Prof. Agassiz, that he is now occupied upon a detailed description of the Echinodermata, the prodrome of this work having appeared some years ago.

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* See this No., page 46, under the doings of the British Association.

In the prosecution of this work, he is exceedingly desirous to obtain specimens of any remarkable species not hitherto described, of these animals, either dead or living; that is, either existing or fossil.

We beg leave, therefore, in behalf of this eminent and very meritorious naturalist, and of the common cause, to call the attention of men of science and of collectors to this subject, and with it to that of fossil fishes, that M. Agassiz may be enabled to include within his works as many American species as possible. Our fossil fishes, (or good drawings of them,) our corals, echini, alcyonia, crinoidea, &c., will be acceptable, and reference may be had to a friend of Prof. Agassiz now resident in New York, M. August Mayor, care of Meyrat Nagath, in the same city, who will transmit specimens to Neufchatel, Switzerland, the residence of the author.

It is exceedingly to be desired that the small list of American subscribers to Prof. Agassiz' great work on fossil fishes should be augmented. While we have had the pleasure of forwarding a few names of individuals or institutions, we should be much gratified to be instrumental in augmenting the number, and now again call upon opulent individuals, and upon all institutions for the promotion of science and good learning, to aid in sustaining this undertaking. A notice of the work and of the terms may be found in Vol. xxviii, p. 193, and a full analysis of the first four livraisons, by Prof. Jameson, in Vol. xxx, p. 33.

4. *Statistical Tables*, exhibiting the condition and products of certain branches of industry in Massachusetts, for the year ending April 1, 1837; prepared from the returns of the Assessors, by John P. Bigelow, Secretary of the Commonwealth: Boston, 1838, pp. 209.

Statistics have as yet occupied but a small part of the attention of the legislatures of our several states, and it is certain that nothing but legislative enactment can ever give us a full view of the varied statistics of so vast a country as this. Mr. Worcester, in the preface to the American Almanac for 1838, remarks justly: "The statistics of the whole country can never be collected by one individual, nor by a society formed for the purpose. If the work is ever accomplished in a suitable manner, it must be done under the direction of the government of the United States. And if the national government should connect this object with the taking of the next census, the design would certainly commend itself to every man of enlightened views, and it would redound to the lasting honor of the administration that should first introduce the system."

The beautifully printed and correct tables under consideration, sent to us by the kindness of the Secretary of the State, present accurate returns from about seventy distinct branches of industry practiced in the Commonwealth of Massachusetts, from which it appears, that the value of her various manufactures for the year ending April 1, 1837, was $91,765,315;

the number of hands employed, 117,352; and the capital invested, $54,851,643. The population of the State is 701,331. Thus it seems that more than a seventh of the whole population are engaged in some branch of manufactures; that the annual value of the industry of each laborer is more than seven hundred dollars; and that their united labor produces a yearly sum nearly double the capital invested.

5. *Crania Americana:* Or a comparative view of the skulls of various Aboriginal nations of North and South America; to which is prefixed an Essay on the varieties of the human species, and on the American race in particular: illustrated by sixty plates, and a colored map. By Samuel George Morton, M. D. Phila., for the author, by J. Fuller. 1838. Folio.

An announcement of the proposed publication of this great work, was contained in the 32d volume of this Journal, (page 207,) although we did not then expect that any part of it would be laid before the public so soon. The part now on our table comprises the prospectus and eighteen beautiful plates. The American press has rarely issued a book in so liberal a style. The figures of the skulls are drawn on stone, with much fidelity and elegance, and of the natural size, one head only being placed on each plate, instead of two, as at first proposed. We are told in the prospectus, that the introductory essay will embrace a brief illustrative view of the human species; the strictly American portion of the work will contain lithographic illustrations of more than forty Indian nations, with a particularly extended series from North America. The extraordinary distortions of the crania of some of the tribes will be illustrated, and those from the mounds and caves of our western territory will form a separate division of the work. The author's materials for the successful completion of his great undertaking, are more ample, probably, than those of any other individual; and as he has no favorite hypothesis to support, we may expect a candid exposition of facts, and a strict adherence to them. Many interesting developments respecting the natural history of man, will doubtless arise from these investigations. The work is in such a state of forwardness, that it is proposed to deliver it to subscribers by the first of October, 1838. We trust that the author may receive sufficient encouragement, especially as he has, single-handed, shouldered the expense of this great undertaking. The work is to be obtained from the publisher by subscription,—the price, $20.

6. *Annals of the Lyceum of Natural History of New York.*—The first four numbers of the fourth volume, under the same covers, of the Annals of this Society, have recently appeared. The article by Mr. J. H. Redfield, on the fossil fishes of Connecticut, has already excited much attention among those interested in that subject, as may be seen by a reference to the remarks of Professor Agassiz, contained in this number. The

other articles are a new mineralogical nomenclature by J. D. Dana. On the structure and Affinities of Ceratophyllaceæ, by Asa Gray. Notice of the appearance of the Pine Grosbeak in the vicinity of New York, by J. F. Ward. Descriptions of five species of Vespertilio, by Wm. Cooper. On two species of Molossus inhabiting the United States, by the same. On two species of American Plecotus, idem. Discovery of Vauquelinite in the United States, by John Torrey. Account of several new Genera and species of North American plants, by the same. Observations on the Genus Sarracenia, including a new species, by H. B. Croom. Melanthacearum Am. Septentrionalis Revisio, Auct. Asa Gray.

It is due to the Lyceum to give circulation to the following notice.

"The object of the Lyceum, in publishing its Annals, is to record new and valuable facts in Natural History; and to advance the public good by the diffusion of useful knowledge. The importance of this science is, at present, every where acknowledged; and the attention bestowed on it, in our own country, has already been amply repaid. A great variety of new, useful, and elegant productions have been discovered; and important facts connected with the agricultural, commercial, and manufacturing interests, have been elucidated. In our attempts to bring to light the hidden riches of our country, we solicit the assistance of the public. We ask no emolument, we expect no gain. We cherish the hope that our exertions will be encouraged; that we shall be enabled to proceed in the course which we have now commenced.

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A number consists of 32 pages, exclusive of plates. Price 25 cents per number.

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Persons at a distance wishing to subscribe for the future Nos. will please make arrangements with some person in the city to receive, forward, and pay for them. Odd numbers to complete sets may also be obtained in the same way."

7. *Description of new species of Mollusca and Shells, with remarks on several Polypi, &c., found in Massachusetts Bay;* by JOSEPH P. COUTHOUY. From the Journal of the Boston Soc. Nat. Hist. Vol. II.

We are pleased to see so much critical knowledge and laborious research brought to bear on the shells and polyps of our coast, as is evinced in the article before us. Its zealous author has discovered nearly all the shells herein described, in the entrails of the sea fish, brought to the Boston market.

The following are the short specific descriptions of the new species; we have not space to copy the remarks or figures which accompany them. Massachusetts Bay is the locality of the species, when not otherwise stated.

TUBULIFERA STELLIFERA. T. tubulis brevibus, simplicibus, aggregatis, carnosis, stellis parvulis purpureis coronatis. Hab. *Boston harbor;* grows about the bottom of the piles at Craigie's bridge.

HOLOTHURIA CHRYSACANTHOPHORA. H. tentaculis— ? corpore molli, cylindrico, cinereo-lutescente, spinis aureis, exilibus, frequentibus instructo.

TELLINA SORDIDA. Testâ ovali, compressâ, albidâ, epidermide corneâ tectâ; dentibus cardinalibus valvâ dextrâ duobus, altero simplici, altero bifido, sinistrâ plerumque obsoletis; lateralibus posticis remotis; intus albâ. Hab. *Boston Bay.*

CARDIUM PUBESCENS. Testa mediocri, obliquè rotundatâ, subæquilaterali, cinerescente; costellis 36, ciliatis; umbonibus tumidis; natibus approximatis; margine crenato; intus albo-lutescente.

NUCULA MYALIS. Testâ ovata, sub-equilaterali, lævi, concentricè zonatâ; latere postico longiore et latiore, rotundato, antico sub-rostrato; natibus approximatis; dentibus rectis; epidermide olivaceo-nigricante.

N. TENUISCULATA. T. elongatâ, inæquilaterali; latere antico longiore attenuato, rostrato, postico rotundato; umbonibus prominulis, concentricè confertimque striatis, tenuissimèque sulcatis; colore virescente.

TEREBRATULA SEPTENTRIONALIS. T. obovata, tenui, albidâ, valvâ majore apud apicem coarctatâ, radiatim creberrimè striatâ, nate emarginatâ foramine magno semi-elliptico, margine non inflexo, denticulato.

EOLIS BOSTONIENSIS. Corpore oblongo, capite brevi, tentaculis quatuor, branchiis cirriformibus, purpureis, apicibus albis, utrinque fasciculis quinis; pede amplo, posticè per-acuto; tentacularum caudæque extremitatibus cyaneo tinctis. Hab. *Tide water of Charles River, Mass.*

**Eolis** (Cavolina, *Brug.*) **salmonacea.** Corpore oblongo, capite lato, tentaculis quatuor, branchiis numerosis, salmonaceis, lineis longitudinalibus dorso dispositis, pede amplo, supra lacinulato, posticè acuto. Hab. *Tide water of Charles River, Mass.*

**Eolis** (Tergipes, *Cuv.*) **gymnota.** Corpore elongato, albido, capite brevi, orbiculato-depresso, tentaculis quatuor, branchiis fulvo-rufescentibus; utrinque fasciculis septem, medio dorsi nudo. Hab. *Tide water of Charles River, Mass.*

**Tritonia Reynoldsii.** Corpore elongato, postice attenuato, papilloso seu verrucoso rubro-fuscescente, maculis albidis notato; tentaculis duabus serratis, vaginulis lacinulatis retractilibus; branchiis arboreis, utrinque quinis, posticè gradatim minuentibus; ore corrugato, branchiis vel ramulis branchiiformibus senis instructo, papillisque numerosis circumdato. Hab. *Tide waters of Charles River, Mass.*

**Chiton fulminatus.** Testâ oblongo-ovali, anticè sub-attenuatâ, plerumque rufo-flavescente aut virescente, lineis albis angulatis et flammulatis pictâ; valvis sub-carinatis, minutissimè granulatis, marginibus posterioribus albo punctatis, areis lateralibus indistinctis; margine pubescente, rufescente, albo maculato.

**C. sagrinatus.** Testâ parvulâ; elongato-ovali, nigricante; valvis sub-carinatis, tenuissimè et concentricè striatis, minutissimè sagrinatis; areis lateralibus indistinctis; valvis terminalibus semilunatis; margine granulato.

**C. Emersonii.** Testâ ovali, anticè paulum compressâ, albidâ, membranâ squalidâ pubescente tectâ, valvis posticè arcuatis, lateribus rotundatis, areis centralibus cordiformibus et granulatis, valvâ anticâ divaricatim lineatâ, posticâ emarginatâ et valdè arcuatâ; valvis intermediis, lineâ bicarinatâ ab apice ad latus posticum obliquè decurrente; margine fasciculis crinitis ordinibus binis dispositis.

**Patella candida.** Testâ parvulâ, ovali, sub-diaphanâ, candidâ concentricè striatâ, costis scabris, exiguis, radiantibus; intus nitidâ.

**Bulla Triticea.** Testâ parvulâ, cylindricâ, albidâ, nitida, epidermide ferruginea tectâ; spirâ depressiusculâ imperforatâ; columellâ basi sinuosâ, leviter reflexâ, albâ.

**Natica consolidata.** Testâ subglobosa, lævi, rufescente, interdum albidâ; spirâ brevissimâ; umbilico parvo, consolidato; aperturâ ovatâ, operculo calcareo lævi; epidermide fusco-virescente.

**Oxinoe? glabra.** Testâ ovali, parvâ, ventricosâ, sub-umbilicatâ albâ, fragili, spirâ brevi, laterali, labro integro, columellâ arcuatâ, aperturâ valde effusâ.

**Jaminia exigua.** Testâ parvulâ, conicâ, albido-pellucidâ; anfractibus convexis; suturis impressis; aperturâ ovali; basi effusâ; columellâ reflexâ, uniplicatâ; epidermide fuscescente.

**Scalaria subulata.** *An.* Corpore spirali, griseo, albo-maculato; pede brevi, crasso, oblongo; tentaculis duabus; oculis parvulis, nigris; ore orbiculato, corrugato; proboscide nullâ; operculo corneo.

*Sc.* testâ acuto-turritâ, obscuro-albidâ, interdùm fuscescente, imperforatâ; anfractibus sub-convexis, contiguis; costis sub-æqualibus, depressis, supernè angulatis; aperturâ ovali; labro basi emarginato, intus albo.

**Scalaria Novangliæ.** Testâ elongato-turrita, sub-perforatâ, albâ, maculis fuscescentibus notatâ; costis parvulis inæqualibus, interstitiis tenuissimè striatis, anfractibus convexis, vix contiguis; aperturâ ovatâ; labro integro.

**Turbo incarnatus.** Testâ sub-conicâ, rubra, anfractibus convexis, transversim creberrimè striatis; basi convexâ, latè profundèque perforata; labro tenui, lævi, intus fulgido; operculo corneo.

**Turbo cinereus.** Testâ pyramidali, tenui, cinereâ; anfractibus convexiusculis costellis numerosis cinctis, longitudinaliter tenuissimè striatis; basi subconvexâ perforatâ; labro tenui, crenulato; intus margaritaceâ; operculo corneo.

**T. obscurus.** Testâ subconicâ, perforatâ, fusco-rubente; anfractibus convexis, supernè leviter angulatis; basi convexâ, aperturâ rotundâ, labro tenui, lævi, intùs iridescente; operculo corneo.

**Pyramis striatulus.** Testâ parvâ, subulatâ, albidâ, transversim tenuissimè striatâ suturis impressis, apertura ovatâ, basi leviter effusâ.

**Turritella erosa.** Testâ turritâ, fusco-rufescente, apice acuto; anfractibus sub-convexis, transversè sulcatis; aperturâ orbiculatâ, labro tenui, sub-crenulato; columella leviter callosâ, epidermide viridi-corneâ.

**Pleurotoma bicarinata.** Testâ perparvâ, fusiformi, turritâ, fusco-nigricante, transversè striatâ et sulcatâ; suturis impressis; anfractibus convexis, medio bicarinatis; aperturâ ellipticâ; labro crenulato, cauda brevi, sinu minimo.

**Cancellaria buccinoides.** Testâ ovato-conicâ, lacteâ apice acuto; anfractibus convexis, transversè sulcatis, longitudinaliter striatis; labro intus candido, denticulato; columellâ leviter callosâ, arcuatâ, triplicata; epidermide olivaceâ.

**Fusus harpularius.** Testâ fusiformi, turritâ, fulvo-lutescente; anfractibus supernè planulatis, costis obliquis numerosis instructis, transversè tenuissimè striatis; apertura obovatâ, labro lævi, caudâ perbrevi.

**Fusus pleurotomarius.** Testâ acutissimè elongatâ, fuscâ; anfractibus convexis, plicis longitudinalibus instructis; aperturâ ovatâ, labro intùs lævi; columellâ arcuatâ, caudâ brevi.

**TRICHOTROPIS COSTELLATUS.** **Testâ ovatâ, turrito-acutâ, fuscescente, epidermide foliaceâ luteo-albida tectâ ; spirâ canaliculata ; anfractibus costis 5-rotundatis instructis ; apertura ovali, lutescente ; labro costis indentato ; columellâ arcuatâ, albescente.**

The Polyps *Tubularia indivisa*, Ellis, *T. coronata*, Muller, *Ophiura lacertosa*, Lam., *Actinia plumosa*, Mul. *Actinia, senilis*, Linn., *have also been observed by the author in the Massachusetts Bay.*

8. *Third American Edition of Bakewell's Geology, from the fifth and last of the author in London.*—Professor Silliman is particularly charged by Mr. Bakewell, with the care of a third American edition of his Geology, to be printed from the fifth of the author. Mr. Bakewell writes to Professor Silliman, under date of February, 1838, that the new edition of his work would be out, in England early in March, and consequently it may be daily expected in this country. It is enlarged by about 80 pages of new matter, has from 15 to 20 new cuts, and contains a chapter on a new topic, relating to coal, hitherto overlooked by all geologists. This work will be printed with all convenient speed by B. & W. Noyes, booksellers and publishers in New Haven, and successors of Herrick & Noyes, and of Hezekiah Howe. The edition will be superintended by Professor Silliman, and by Mr. Robert Bakewell, Junior, son of the author.*

9. *Olmsted's Natural Philosophy*, 2 vols. 8vo.—A new and improved edition of this work, is in press, and will shortly be ready for delivery.

10. *Second report of the Geology of Maine.*—Since the notices of the geological reports were written, this has come to hand, but too late for mention in our present number.

### INTELLIGENCE.

1. *Return of the Bonite, from a voyage around the world.*—We are happy to see it announced from the French papers, that the Bonite sloop of war, which left Toulon on the 8th of Feb., 1836, has arrived at Brest, after an absence of twenty-one months. The crew consisted of 151 men, under the command of M. Auguste Vaillant, Capitaine de Corvette.

The return of this vessel was anxiously looked for by the scientific world, in the belief, as well from the character of the scientific corps, as from the specific instructions of M. Arago, and others of the Academy of Sciences, that many important discoveries would be made, going far toward the elucidation of interesting questions in magnetism, meteorology, and other branches of science. For a knowledge of what has been accomplished we must await the published account of the voyage, which the French government, with their former liberality, will no doubt soon place in our hands. The scientific corps were, *in botany*, M. Gaudichaud, who has before circumnavigated the world in L'Uranie; in zoology, M. Eydoux, naval surgeon of the first class, who sailed round the world in L'Favourite; in geology, M. Chevalier Enseigne de Vaisseau; in astronomy, M. Chevalier Fouchard; in hydrography and observations on terrestrial magnetism, in connection with the other officers of the ship, M. Darondeau. M. Lauvergne, the same artist who has twice before been around the world in the Astrolabe and the Favourite, was draftsman to the expedition. What is most singular, is the fact, that not one person died out of the whole crew and numerous passengers; nor did any serious illness appear, except a few cases of scurvy, towards the close of the voyage. This extraordinary exemption is to be attributed to the watchful care of the captain, in airing the vessel, and enforcing exact cleanliness among his men, and making them suit their dress to the climate they were in, and to the diurnal variations of the temperature. No accident occurred to the vessel herself.

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* For a notice of this gentleman see Vol. XXXI, No. 1, of this Journal.

## OBITUARY.—THE HON. NATHANIEL BOWDITCH.

The death of this excellent and illustrious man has left a void in the American scientific world, which it will be very difficult to fill.

His reputation was not merely American—it was European—it belonged to his fellow-men of every enlightened and christian land.

We heard of his extreme and hopeless illness, and almost immediately after, of his death, with acute pain, and with a sense of hopeless bereavement—hopeless, as regards the prospect of looking upon his like again.

The following able obituary from the pen of an eminent scholar, and one intimately acquainted with Dr. Bowditch and his history, appeared in the Boston Daily Advertiser and Patriot of March 17, 1838, and we, without hesitation, adopt it, as better and fuller than any thing which our more limited acquaintance with Dr. Bowditch would enable us to prepare. We are happy, however, to learn that a more ample biography will be written by the same able hand, and will appear in the Memoirs of the American Academy of Boston. While waiting for this full portrait of one of the most distinguished men of his age, we will venture only to add, that from opportunities which we were so fortunate as to enjoy, of familiar interviews with Dr. Bowditch, in the bosom of his amiable and happy family, we were not less delighted with the warm and generous expression of his private affections, and the frank assuring impress of his manly manners, than we had been, before knowing him, with the splendor of his public reputation. Of the latter, he appeared to be almost the only person who was unconscious; and if he was great to the world of mathematicians and astronomers, he was delightful in the hours and scenes of the domestic and evening circle.*—Ed.

It gives us pain to announce the decease of our distinguished townsman, Dr. Bowditch, which took place yesterday, at 1 o'clock, after an illness of several weeks.

The death of this eminent man will be felt in America as a national loss. His name was identified with the science of his native country; and our national character, with men of science abroad, is indebted to no one individual—with the exception, perhaps, of Dr. Franklin—so much as to him.

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* The President and faculty of Yale College, where Dr. Bowditch's character was much honored, on hearing of his death, transmitted to his children, resolutions expressive of their high veneration for the deceased—of their deep sense of the loss to the nation and the world, and of their sympathy with his bereaved family.

Dr. Bowditch was born on the 26th of March, 1773, at Salem, in the State of Massachusetts. In his education, he had no other advantages than those afforded by the common town schools, which at that period were comparatively meagre, and inadequate to the great purposes of disciplining and storing the mind with knowledge.

At the usual age, he was placed as a clerk, or apprentice, in the store of a merchant in Salem; and while in that situation, it is said, he used to employ his leisure time in his favorite science of Mathematics, and various practical subjects connected with it.

His attention was directed, at an early age, to the *Principia* of his great master, Newton. But, as this work was published in the Latin language, which he had not then learned, he was obliged to begin his reading of it, by asking some of the Cambridge students, during their vacations at Salem, to explain it to him in English. He soon discovered, however, that his own knowledge of the subject, with the aid of the mathematical processes and diagrams on the pages of the Principia, enabled him to comprehend the reasoning contained in the modern and technical Latin of the work, more readily than he could do with the help of the superior knowledge which the University students possessed of the Latin of Cicero and Virgil; and he was soon convinced that his shortest course would be to acquire a knowledge of the language for himself; which by great perseverance he accomplished, and was enabled to read any work of science in it. And thus he was another instance, like that of the ancient Greek writer, who relates of himself that during his residence at Rome, he obtained a knowledge of the *language* of the Romans, by his knowledge of the *subjects* which they discussed in it. He afterwards learned French, for the purpose of having access to the treasures of French mathematical science; and, at a late period of his life, he acquired some knowledge of the German language.

A little circumstance connected with his study of Newton's Principia, will not be uninteresting to the learned and the unlearned. The Latin copy of it, which Dr. Bowditch used, was presented to him by a mercantile friend in Salem, who made no pretension to science, and would never have thought of opening the work; but he had preserved it, in his little library of popular works, as a book, that possibly might one day be of use to some person. By a remarkable coincidence of circumstances, the volume came to the knowledge of Dr. Bowditch; and his friend, upon being requested to lend it, with great liberality presented it to him—the man who, above all others in the country, was the best able to make the most advantageous use of it. So far as great effects may be justly said to flow from small causes, what important consequences may have followed from the preservation of this single and apparently worthless volume, by an individual who could make no use of it! Dr. Bowditch sometimes alluded to this occurrence; and, on the occasion of presenting a copy of his La Place to a friend, who declined taking it because he was no better able to read it than his mercantile friend could the Principia, delicately insisted upon its acceptance; and, in the last resort, reminded his friend, that if not useful to him personally, it might, perhaps, be placed in the hands of some one, to whom it might be valuable, as the copy of the Principia had been to himself.

Dr. Bowditch did not remain long in the situation of a merchant's clerk. His mathematical talent, in a town eminently distinguished for nautical enterprise, could not fail of being called into exercise, in connection with the art of navigation; and a large portion of the well known skill of the navigators of Salem may justly be considered as the fruits of the instruction which may be traced, directly or indirectly, to his scientific acquirements. He was, besides, a practical navigator himself for a few years, principally, if not exclusively, in East India voyages, which gave him the most favorable opportunities of rendering his mathematical studies practically useful to the nautical interests of his country.

At that period, the common treatise on navigation was the well known work of Hamilton Moore, which has occasioned many a shipwreck, but which Dr. Bowditch, like other navigators, was obliged to use. Upon examining it, however, in his daily operations, he found it abounding with blunders and overrun with typographical errors, particularly in the Nautical Tables, in which, above all parts of the work, great accuracy was indispensable; of these last errors, many thousands, of more or less importance, were corrected in his early revisions of the work. He published several editions of Moore's work under that author's name; but the whole fabric at length underwent so many changes and radical improvements by the addition of new, and the rejection of old and worthless matter, as to warrant his publishing it under his own name; and the work of Moore is now only remembered from its having been superseded by "Bowditch's Navigator."

It may be added, that he was enabled to give the greater accuracy to his work by means of a collection of manuscript *Journals* of his seafaring townsmen, preserved in the valuable East India Society's Museum, in Salem. By a rule of that association—which is believed to have been proposed by Dr. Bowditch—each member was required to carry with him on every voyage, a blank book, methodically arranged, for the porpose of keeping a journal of observations and remarkable occurrences; these journals (now amounting to many volumes) at the end of the voyage were returned to the Museum; and they form a repository of innumerable observations in nautical and geographical science not to be found in any other sources.

In connection with this part of the subject, it should be further observed, that Dr. Bowditch also employed himself during several seasons (1805, '6, '7,) in making an elaborate hydrographical survey of the harbor of Salem, with the adjacent harbors of Marblehead, Beverly, and Manchester; of which he published an admirable chart of surpassing beauty and accuracy. With such extraordinary exactness was this laborious work performed, that the pilots of the port discovered, and were the first to observe to the author, that many of their landmarks—which, however, Dr. B. did not know to be such—were in fact laid down with such perfect accuracy in the survey, that the various ranges on the chart corresponded with the utmost possible precision to those of the natural objects.

The ardor and perseverance which distinguished Dr. B. through life, were very early conspicuous in the prosecution of his mathematical and philosophical studies. While his pecuniary means were very limited, he used to make copious abstracts of the scientific papers in that immense repository, the Philosophical Transactions of the Royal Society of London: this labor was continued through many years; and the numerous large volumes of these manuscript abstracts in his library, embracing a great portion of that whole work, still remain the testimonials of his untiring industry and zeal in the cause of science.

During a large part of his life he was a principal contributor to the Memoirs of the American Academy; and it is unnecessary to add, that his communications are among the most important in that work. He is also the author of a few reviews in the leading journals of the time.*

In the year 1806, at the particular instance, as it was said, of the late Chief Justice Parsons—whose extraordinary attainments included a knowledge of the higher branches of mathematics—Dr. Bowditch was elected Professor of Mathematics and Natural Philosophy in the University of Cambridge. He could not, however, be persuaded to accept the office; principally, it is believed, if not wholly, from an apprehension that the circumstance of his not having been educated at that university might render the discharge of his duties less satisfactory to himself than he could wish. Those who knew him best, however, often remarked upon his extraordinary power of communicating instruction in the clearest manner; and Chief Justice Parsons, as competent a judge in the case as could be found in any country, has said to the writer of this notice, that of all the men he had known, he had never found one who could make any mathematical proposition so transparently clear and intelligible by mere oral statement, without a diagram or figures, as Dr. Bowditch. It may also here be added, that Dr. B. had the highest respect for the great mathematical attainments of Chief Justice Parsons; and it may be interesting to many persons to know, that under the Rules for Lunar Observations in the "Practical Navigator," Dr. B. has introduced an improved method of correcting the apparent distance of the moon from the sun or a star, which was suggested by that great man, whom he justly characterizes as "eminently distinguished for his mathematical acquirements."*

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* In the Monthly Anthology and North American Review.

It should have been before stated, that after quitting the life of a navigator, Dr. B. held the office of president of a marine insurance company in his native town for several years; until, upon the establishment of that well known and invaluable institution, the Massachusetts Hospital Life Insurance Company, in Boston, his talents were deemed indispensable in its organization and management; and he was invited to take charge of it, under the title of its Actuary. The great exactness of calculation and the order and precision introduced by him into that institution, will long attest the comprehensiveness of his views and his facility in the practical management of its affairs.

On the occasion of leaving his native town to enter upon his new office, his townsmen spontaneously united in a public dinner, as a testimonial of their respect and grateful recollection of his eminent services to his country and of his great private worth.

While he resided in Salem he undertook his well known translation of La Place's *Mécanique Céleste*, accompanied with his invaluable Commentary upon it. This truly gigantic task was begun in the year 1815, and has been the steady occupation of his leisure hours to the time of his death. His elucidations and commentaries, while they show him to have been as thoroughly master of that mighty subject as La Place himself, will make that great work—the most profound of modern times—accessible to innumerable students, who without such aid would be compelled to forego the use of it.

The labor of translating and commenting on the whole of that work had defied the zeal and industry of the scientific men of Great Britain; and one of their leading journals gives due credit to America for this extraordinary and honorable achievement in the cause of Science, which had not been accomplished by any individual among the numerous scientific associations of Great Britain.

"The idea," says the journal alluded to, "of undertaking a translation of the whole *Mécanique Céleste*, accompanied throughout with a copious running commentary, is one which savors, at first sight, of the *gigantesque;* and is certainly one which, from what we have hitherto had reason to conceive of the popularity and diffusion of mathematical knowledge on the opposite shores of the Atlantic, we should never have expected to have found originated—or, at least, carried into execution in that quarter. The part actually completed [the first volume,] is, with few and slight exceptions, just what we could have wished to see—an exact and careful translation into very good English—exceedingly well printed, and accompanied with Notes appended to each page; which leave no step in the text, of moment, unsupplied, and hardly any material difficulty either of conception or reasoning unelucidated."*

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* Bowditch's Navigator, p. 161, edit. 1811.

The progress of Dr. Bowditch's last illness was so unremitting, that he was not able to complete the final revision of the whole of this great work. He had, however, corrected the last sheets of the fourth volume a few days before his death, and while his physical powers were scarcely capable of executing what his clear and unclouded intellect dictated. The fifth, and only remaining volume is, comparatively, of little importance, and it would probably have had but slight revisions, even if he had survived.

On this great work Dr. Bowditch's fame, throughout the scientific world will ultimately rest. And, surely, the most lofty ambition could not desire a more solid and lasting monument—a monument, which will endure until that day of desolation shall arrive, when no one of the human family shall remain to contemplate the mighty fabric of those heavenly systems, whose structure and laws are inscribed upon it.

The long study of the French mathematicians, in connection with Dr. B.'s labors on La Place's work, had given him a well founded partiality for the French, or Continental mathematical school, so far as that may be said to differ from the English. And on one great question, which in the age of Newton raised such a furious tempest of altercation between the English and Continental mathematicians—the quarrel between Newton and Leibnitz for the immortal invention of the differential calculus—Dr. Bowditch did not consider Newton as the exclusive discoverer, but, as the more candid of all parties now generally agree, that he and Leibnitz were both original discoverers of that wonderful method of analysis, and that neither of them was a plagiarist from the other, as each had been illiberally called while the controversy was raging.

The reputation of Dr. Bowditch was such, that he had for many years been a member of various learned societies in Europe and America; and he was one of the few Americans who have been Fellows of the Royal Society of London. In his native State he has been for some years the President of the American Academy of Arts and Sciences, which is indebted to him for a large share of the reputation it has enjoyed.

Such is a brief outline of the intellectual character and scientific labors of this eminent man. It need only be added, that in social life he was distinguished for rigid integrity, extraordinary energy of character, and unremitting zeal and perseverance in whatever he undertook to accomplish; his manner was ardent, and indicative of that warm heart which has now ceased to throb for those friends who enjoyed the happiness of his society; his deportment was, in an extraordinary degree, unaffected and simple; and he had a frankness in expressing his opinions, which an age of artificial civility would feel to be a standing reproof of its own heartlessness, and would hardly consent to rank among the virtues.

How saddening is the reflection, that these high intellectual and moral endowments, from which we had fondly, perhaps unreasonably, hoped for still further benefits to the world, should now lie powerless, prostrate, and in ruins before us! Never has there been an individual in our country, solely devoted to the pursuits of science and the tranquil walks of private life, and shunning the allurements of that political notoriety which is the distempered and all-absorbing passion of the day, whose death has been more generally and deeply lamented—

"Multis ille bonis flebilis occidit"—
"We read his history in a nation's eyes;"

and the demonstrations of sorrow in every face are at once a spontaneous homage to science, and a heart-felt tribute to eminent private worth.

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* London Quarterly Review, vol. 47, July, 1832.

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## ART. I.—*Description of a Crustaceous Animal, belonging to the genus Caligus—C. Americanus;* by CHARLES PICKERING, M. D. and JAMES D. DANA, Members of the Yale Natural History Society.

Read before the Yale Nat. Hist. Soc., Feb. 20, 1838.

THE species of the genus Caligus, and of other allied genera, are commonly called *fish-lice*, in allusion to their parasitic mode of life. The individuals which are the subject of the following remarks, infest the Common Cod* of this part of the American coast.

During the fall of the year, when the shoal fish are brought to the New York market,† the Caligi are exceedingly abundant. Occasionally, forty or more individuals may be taken from a single fish. As the season advances, the fish are taken in fewer numbers off Sandy Hook and Long Island, and afford a much smaller proportion of parasites. The Caligi are most numerous on the half-grown fish; they are found indiscriminately on the head or different parts of the body, but never within the gill-covers. A European species has been said to live under the scales: we have never observed this peculiarity in the species on this coast; indeed, the closeness of the small scales of the cod, renders it impossible.

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* It has not been satisfactorily ascertained whether the cod of this coast is identical with the European species, Morrhua vulgaris; this, however, is the common opinion.

† These investigations were made at the city of New York, and occupied the latter part of November last, together with the following months, December and January.

When disturbed, they move with rapidity over the fish, and either backward or forward with nearly equal facility. In swimming, their motion is equally rapid. They thus travel over the body of the fish at will, and, we doubt not, occasionally leave one fish for another.

Both sexes frequently occur on the same fish, though the females (during the months of November, December, and January) have been far the most abundant. The latter are, in general, readily distinguished by the two filiform appendages to the body, which are the external ovarian tubes; or, if these are wanting—as often happens—by the larger abdomen, whose greater size is owing to the eggs it contains. If destitute of eggs, it does not present this peculiarity. The sexes differ, moreover, in the form of the first and third pair of feet, as will be particularly noticed when speaking of these members.

The sizes of the individuals which have come under our notice, have been very various. The adult males frequently attain a length of five ninths or nearly two thirds of an inch, (fig. 2, Pl. III.) The females are always smaller than the males, and seldom exceed a half inch, exclusive of the ovarian tubes, (fig. 3.) The smallest individual seen, was one tenth of an inch long. Its legs had less slender proportions than usual; otherwise, it did not differ from the adults.

The Caligi live several hours on the body of the cod taken from the water; but generally die soon after the death of the fish. When taken from the fish and confined, they exhibit a strong inclination to leave the water. We have often observed, after the introduction of fifteen or twenty into a glass of salt water, that the greater portion of them seek the surface, where they attach themselves to the glass; and quite a number leave the water entirely, crawling up the glass an inch or two above the surface. The water they confine under their broad shell, which is closely attached at its margin, supports them for a while; but, unless assisted again to their element, they remain, without any apparent attempt to return, and in a few hours die.

These animals, like the cod, on which they live, require a low temperature, and have been observed to swim, with scarcely diminished activity, in water that was freezing. In some instances, when the water had evidently reached a temperature below 32° F., without congelation, they have been rendered torpid, and apparently dead; but on bringing them into a room not above 45° F., they have soon resumed their usual activity. When the temperature has been as high as 60° F., they have generally died in the course of a short time. This may be owing in part to the deterioration of the air in the water, arising from the decompositon of the animal matter contained in it. They die almost immediately when thrown into fresh water.

Although the imperfect descriptions of the European Caligi, by early authors, have been improved by subsequent investigators, still, in consequence of the obscure structure of these animals, their characters are yet very inaccurately described. We have therefore been unable to satisfy ourselves fully, that the species of this coast is distinct from the European. Yet, as many of the characters stated respecting the foreign species, do not apply to ours, we have ventured to propose it as new, under the name given at the head of this article.* The following description, together with the accompanying plates, it is hoped, will enable the future investigator of the European individuals to decide in regard to their identity.

The results of our investigations have shown, that many of the errors of authors are of the most fundamental character. Among the principal of them, we find that a front pair of cups, serving for the attachment of the animal, have been mistaken for its eyes;—the exserted ovarian tubes have of late been considered the respiratory apparatus;—and what is still more essential, as it affects the late classification of the Crustacea, the mouth is supposed to be a sucker, whereas it contains large dentated mandibles, and other manducatory organs, appertaining to the maxillated species. This last character has been proved to belong also to the Argulus, another of the *Siphonostoma*, or *Crustacés Suceurs*, in an article on that animal, in this Journal, Vol. xxxi, 1837.

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* We find in a folio volume by M. Duhamel du Monceau, entitled *Traité Générale des Pesches*, MDCCLXXIII, *Paris*, at page 294, a description of the Caligus found on the Salmon, accompanied by drawings, which, if at all accurate, show that the species are not identical. The same conclusion may be drawn from Desmarest's figures in his Gén. Consid. des Crustacés, if they can be relied on. Other figures that we have seen are so evidently inaccurate, or so destitute of details, that we would not venture to form an opinion from them.

## I. TEGUMENTARY SYSTEM.

### a. *Segments of the Body.*

The body of the Caligus is provided with a flexible, subcorneous, and perfectly transparent covering. By dissection, we were able to distinguish only two coats. The internal is a thin, moist membrane, easily separable from the exterior, and often presenting, especially in old individuals, numerous dendritic delineations of an ochre-yellow color. Occasionally, they are so abundant as to give the animal an ochreous tinge. The exterior coat or shell is pellucid, very flexible, and somewhat elastic, and does not exhibit a fibrous structure. In some portions of the shell, and particularly about the eyes, it is divided into areas, as represented in fig. 8, Pl. IV. The shaded subtransparent area in this figure passes longitudinally over the space between the eyes.

When the animal dies, it assumes, after some time, a rose-red tint. Under the microscope, this color is found to be disposed in dendritic delineations, like the yellow color above noticed, and apparently in the same membrane with it; and in a few instances, we are confident that the dendrites which before were yellow, have this reddish hue. We cannot say that this is true of all these delineations.

The body is composed of four distinct segments, (fig. 7,) of which the first two include the head and thorax, and the third and fourth, the abdomen. The anterior of these segments, which we may designate the *cephalo-thoracic*, is divided into four portions, by imperfect articulations. Two of these articulations are longitudinal, and separate the lateral portions of this segment from the central. The other articulation connects the centre of the two longitudinal articulations, like the cross-line in the letter H, and thus divides the central part of this segment into an anterior and posterior portion. The two lateral portions correspond to the united epimeræ of the higher crustacea, and may be called the *epimeral* segments; the anterior of the two central, may be called the *cephalic* portion, and the posterior forms the anterior portion of the *thorax.* The anterior or cephalic segment presents an imperfect articulation near its front margin, which separates a narrow segment; this segment we shall hereafter designate the *anterior* or *first cephalic* segment, and the remaining portion the *posterior*, or *second cephalic* segment.

Viewed as a whole, the *cephalo-thoracic* segment is slightly convex, and has an obtuse ovate form, a little broader posteriorly, with an emargination in front, (A, fig. 7,) and a deep sinus on each side in the posterior margin, (B.) It is bounded, both anteriorly and laterally, by a thin transparent margin, which appears transversely striated, when highly magnified. The lateral margin is about four times as wide as the anterior. A row of extremely minute curved spines project above the junction of the membranous margin, as is exhibited in figs. 1 and 19. Similar spines are scattered over the back; but a very high magnifying power and the most favorable light are required to discover them.

The articulation of the first with the second cephalic segment, though mostly imperfect, approaches a perfect joint towards each side, (C, fig. 7,) where there is an osseous process in the two segments, with opposite articulating surfaces. The process on the first segment is narrow, and transversely oblong. That on the second is long and slender, and extends to a point laterally in advance of the eyes; it is much enlarged at the articulation, and at that place resembles the process on the anterior segment.

The articulation of the cephalic with the thoracic portion of the cephalo-thoracic segment of the body is curved parallel with the anterior margin of the animal, and terminates on each side, near the centre of each lateral half of the cephalo-thoracic segment, (D, fig. 7.) From this point the articulation of the epimeral with the central segments commences. A thin semi-corneous margin extends from the cephalic segment, and covers its articulation with the adjacent parts. The junction of the epimeral and cephalic segments is directed towards the anterior portion of the lateral margin, but becomes obliterated before reaching it; the junction with the thoracic segment is continuous in a curve, concave inward, to the posterior margin just outside of the sinuses in the latter segment. An osseous articulation, similar to that between the two cephalic segments, unites the epimeral and cephalic segments, (E, fig. 7;) the process on the former is long and slender, and curves backward, giving firmness to that portion of the shell.

The *thoracic* portion of the cephalo-thoracic segment approximates to a circular form. The sinuses before referred to, (B, fig. 7,) are situated in its outer posterior margin. Between each sinus and the articulation of the epimeral segment, there is a narrow lobe, which is provided, on its interior margin, with a folded membrane. The lobe is slightly movable upon a joint at its base, and the membrane has a very free motion, and serves to close the sinus.

The *posterior thoracic* segment (F, fig. 7,) is quite short; its breadth nearly equals one third of the greatest breadth of the anterior portion of the body. Laterally it terminates in an angle, from the posterior side of which, the legs arise which belong to this segment.

The *first abdominal* segment (G,) differs in form in the two sexes. In both, the length and breadth are nearly equal, though in general the former is somewhat greater in the female, and the latter in the male. The sides are much curved in the male, (fig. 7,) and the whole is narrower anteriorly. In the female, (fig. 18,) the form approaches a square with rounded angles. The posterior angles in the male are projecting, and furnished with three short hairy setæ; the same in the female are provided with the same setæ, but they scarcely project beyond the adjoining parts. These peculiarities only exist in the gravid female. When the abdomen is destitute of eggs, it resembles that of the male.

The *remaining abdominal* joint, (H, fig. 7,) has a flattened subovate form, and is about two thirds the breadth of the preceding. Two short leaf-like appendages are obliquely articulated with its posterior extremity. These leaflets are furnished with three terminal plumose setæ or pinnulæ, the ciliæ of which have a length equal to three times the breadth of the seta. There are two short setæ exterior to the pinnulæ, and one interior. These leaflets are ciliated on their internal margin.

b. *Organs appertaining to the several segments.*

1. *Anterior Cephalic Segment.*—This segment presents, in its front emargination, (A, fig. 1,) two minute rounded papillæ, covered on their inner surface with very short hairs, which appear to correspond to the inner antennæ of other crustacea. Below and just behind their insertion we observe a small semicircular process convex outward, which projects a short distance beyond the surrounding surface.

Toward the lateral extremity of this segment, on its lower surface, there is a remarkable organ, which the animal employs in attaching itself, (I, fig. 1 and fig. 19,) but which has heretofore been considered its eyes. It consists of a thin nearly circular membrane, attached by its central portions. Its surface is finely marked with lines running towards the outer margin; on the inner margin, these lines, though possessing the same general direction, freely anastomose. We have often tested the use of these organs by applying the blade of a knife to the front margin below, while the animal was on its back, when in numerous instances it has adhered with sufficient force to be lifted from the fish and carried some distance. The membrane of the segment extends beyond the cup and curves around over the base of the antenna adjoining, (fig. 7, Pl. IV.) These antennæ have no connection with the cup.

About two fifths of the distance from the cup to the centre of the front margin, we find, on the back, a single slender naked seta. (K, fig. 1.)

The *antennæ* which terminate laterally this first cephalic segment, (L, fig. 1, and fig. 19, Pl. V,) are articulated with it by a joint passing obliquely upwards and inwards, towards the cup. They are two-jointed. The first joint is broad and large at base, and somewhat triangular in form. Its anterior and apical portions are covered with soft ciliated oblong papillæ, (fig. 19,) each of which receives a distinct branch of the large nerve that passes to this organ. They shrink up and become obliterated on drying, and in this respect differ from similar appendages to other parts of the body, and even from the naked setæ that terminate the apical joint of the antennæ. This apical joint is nearly cylindrical in form and is about two thirds the length of the basal. The terminal setæ are of two kinds; those at the inferior part of the apex are slender and acute, and those at the superior part, short and somewhat obtuse. A single naked slender seta, usually curved or bent, may be observed near the middle of the posterior margin of this joint.

2. *Posterior Cephalic Segment.*—The *mouth*, (figs. 1 and 12,) is situated in an oblong mass, which lies entirely external, along the under surface of the body, near the centre of the posterior cephalic segment. This buccal mass is in part a hollow organ, (fig. 12, Pl. IV,) bounded above and below by distinct membranes, a portion of which represent the upper and under lip. It has a lunate opening between the approximating lips, (a a and b, fig. 12,) and contains a pair of strong mandibles and other organs, which we shall soon describe. It is articulated with the cephalic segment by its broad posterior portion.

The lateral and anterior margin of the buccal mass is formed by a slender bone, (c b, fig. 12,) which forms a projection posteriorly where it suddenly curves around inward, and runs backward a short distance nearly parallel with the margin. These bones form the sides to the *lower* membrane of the cavity of the mouth. At the anterior extremity of the buccal mass within, they are connected with several small bones which run to the medial line of the mouth, and constitute part of its manducatory apparatus, (m, l, and n, fig. 13, r, s, t, fig. 17, an under view;) these bones lie either on or in the lower membrane of the mouth. No portion of the *upper* membrane of the buccal mass is connected with the bones of the lateral margin except a small subtriangular piece near the anterior angle, (d a e, fig. 12.) These pieces leave between them and the anterior margin of the buccal mass a semicircular opening; the edges of this opening are furnished with ciliæ, and constitute the lower margin of the lunar opening, or the *lower lip.* This lower lip is divided at its centre, (b, fig. 12,) and the edges thus formed are curved inward, so that in a vertical view several ciliæ are projected together, and have the appearance of one branching cilia.

The whole membrane forming the upper portion of the buccal mass may be called the *upper lip.* It is represented separate in fig. 15. It is united with the lower portions, at its posterior extremity, (p p, figs. 12 and 15.) It may be viewed as consisting of two parts, an anterior movable, and a posterior, apparently immovable. The *movable* portion, which is very much the smallest, is an elliptical, nearly circular, membrane, inserted in a semicircular concavity (a a) in the anterior margin of the *immovable* portion. Its front edge is coarsely subcrenated and furnished with ciliæ. The large immovable portion of the upper lip is bounded by a bony edge, on all sides except posteriorly. At f, (figs. 12, 15,) there is a curved process elongated outward, serving for the attachment of a muscle.

Through the opening between the lips, (fig. 12,) we may observe the two slender bones l, (fig. 13,) and just within these, there are visible, through the membranes, two dentated organs, which, when the membranes above are removed, appear as represented in fig. 14. These organs are the *mandibles.* They are long slender organs with a falciform termination, curved inward and dentated on the interior edge; the number of teeth is about twelve. The outer margin of the dentated portion is provided with a narrow corneous transparent edge. These mandibles extend backward and pass out of the buccal mass just anterior to the lateral projection, c, (figs. 12 and 13,) and behind the process, f. Here they are connected with a bony tendon, to which the large muscles are attached which move the mandible. The mandibles have no appendages, and are very slightly connected at their base with the membranes of the buccal mass. When the buccal mass is separated from the body by force applied below, the mandibles invariably remain attached to their muscles.

The remaining corneous organs at the extremity of the mouth have been already described as connected with the lower membrane; the two pairs m, l, on the surface of this membrane, and the remaining, in its texture. The pair l, have just been referred to as seen through the opening between the lips. These bones approximate at their apices; at the other extremity they curve backward and terminate under the junction of the two lips, (fig. 13, and a a, fig. 12;) the bones, m, which are situated under the mandibles, are very finely pectinated on their outer margin; they terminate at the same place with the preceding pair.

The remaining bones form a kind of frame work for the lower membrane. Three slender bones r, s, t, (fig. 17,) occupy the extremity of this membrane, and the bones, o, its inner portion. The bones, o, extend backward and enlarge at the posterior part of the buccal mass, (g, fig. 17,) where they serve for the attachment of the muscles elevating the buccal mass. They appear to form by their union at their anterior extremity, (figs. 17 and 13,) a short, oblong process (k,) which is situated between the apices of the pectinated bones, m. The piece, n (figs. 13 and 17,) passes directly outward from this process, and is gradually lost in the membrane.

This complicated apparatus, the buccal mass, appears to be composed of the upper and lower lips, united with the different parts of a pair of maxillæ.

We have often observed through the upper membranes of the buccal mass, and just in advance of the bony arch a, a, fig. 12, an obscure curved line nearly concentric with the anterior margin of the buccal mass, (fig. 12,) which is frequently in motion. From the peculiarities of its action we suppose that there is here an internal opening to the esophagus. Within this inner mouth, if we may so call it, there are several folds seen below, (fig. 17,) which may be the seat of the sense of taste. Above we observe, (fig. 12,) four fleshy oblong organs extending from a point deeply situated near the base of the esophagus, obliquely upwards to the upper part of the buccal mass. At their lower extremity, they are connected by a slender ligament with the bone, g. These organs appear to close the esophagus. They often open and close in consequence of the similar action of the processes, g, with which they are connected.

The articulation of the buccal mass with the surrounding parts is formed by means of a bony process situated in it below f, and another slender process (h, figs. 12 and 17,) extending backward and outward in the adjacent teguments. A curved bony process, (i, fig. 13,) connects the projection c (figs. 17, 13,) with the process below f, uniting the two portions of the buccal mass.

The remaining organs of the *cephalic* segment consist of four pair of feet, corresponding to the second pair of maxillæ and the three pairs of maxillipeds in the decapodous crustacea.

The *first pair* are three-jointed. The basal joint is broad and oblong, and is connected with the body by its long posterior side. At its inner extremity, which is directed outward nearly parallel with the basal, it curves upward and receives the following joint. The two terminal joints are very different in the two sexes. In the *male*, (fig. 1,) the second joint is large and subconical, with an obliquely truncated apex. It appears to be composed of two joints, but there is no articulation. The terminal joint is obliquely articulated with the preceding; it is small and short, and terminates in two strong curved spines, occupying like horns the lateral portions of the apex. A slender seta is situated on the outer margin, and another on the inner surface near the articulation. The exterior of the apical spines is often brought in contact with a prominence on the apex of the preceding joint. In the *female*, (fig. 18 and 18 a,) the second joint is large, but scarcely longer than its breadth. The terminal joint gradually tapers with an irregular curve to a pointed corneous extremity, which is bent downward at right angles with the preceding part. The basal joint is peculiar in having a stout spine directed backwards, on its posterior margin.

Exterior to the outer portion of the basal joint of this leg, there is a large hooked spine, arising from a broad base, and having an oblique position. This may be considered an appendage to the maxilliped just described. It is similar in the two sexes.

The *second pair* of maxillipeds are rudimentary. They are situated along side of the buccal mass. The basal joint is a large fleshy mass, having a strong spine directed backward on its posterior side, (fig. 4, a.) Upon this mass near its anterior part, there is a very short cylindrical leg, of a single joint, which bears at its apex a long slender spine, and three or four small seta. It moves in every direction, and the spine is as frequently pointed inward or backward, as in the manner given in the figure.

The legs of the *third pair* are situated each on a fleshy base, just exterior to the spine of the preceding pair. They are long and slender, and composed of three joints. The basal joint is rather longer than the two terminal joints of the first pair, and diminishes very gradually to its apex. The second joint is one third longer than the basal, and about one fourth as large, and is of uniform size throughout. At its apex, below, it has a slender *ensiform* extension, which is doubly edged with a finely pectinated membrane, (fig. 4, b.) The terminal joint, is very similar to the process just described, but is much longer. A single short spine is situated on the second joint, a short distance from the articulation of the terminal joint.

*The fourth pair*, the last of those on the cephalic segment, is very dissimilar in the two sexes. In the *male* (fig. 1,) it consists of a very large basal joint, articulated at its extremity with a stout terminal claw, which curves inward and is usually brought in contact with a strong spine near the apex of the basal joint. The breadth of the basal joint is nearly one half its length, except at its insertion, where it is quite small. Between the strong spine just noticed, and the apex of this joint, there is a small fleshy prominence, and a stout spine. The terminal claw has a small seta near its apex.

In the *female*, (figs. 18 and 18 b,) the greatest breadth of the basal joint is scarcely one fourth its length, and it is destitute of the strong spine, near the apex; in some young females we see traces of it, and the leg has more bulky proportions than here stated. The terminal joint is much longer and larger, and more fleshy than in the male; it has a short spine at its apex, and three or four short setæ.

The remaining pairs of legs are four in number; three pertain to the anterior thoracic segment and one to the posterior.

3. *Anterior Thoracic Segment.*—The first two pairs of legs on this segment are natatory, the third is expanded into a broad apron. Preceding the first pair of these legs, there is, on the medial line, a broad furcate corneous process, directed backward, and capable of being elevated or depressed.

The articulations of the two pairs of natatories with the body are very remarkable. These organs not only move on their respective sternums, with which they are articulated, but the sternums have a hinge motion on their posterior margin, in which the legs participate. For this purpose the basal joints are attached to the adjoining parts of the venter by the greater part of their anterior side. The whole distance between the apices of the basal joints in the first pair of natatories, forms thus a single hinge on which the legs revolve; and in the second pair of natatories, the greater portion of the second joint is similarly attached, and for the same purpose.

Several of these joints are provided with long, finely ciliated setæ, or pinnulæ, similar to those terminating the abdomen, which renders them well adapted for swimming. The ciliæ, though very long, are exceedingly slender. The pinnulæ appear to be mostly hollow. They contain a central longitudinal line, which appears on the first view to divide them into two portions; further examination has led us to believe that this is not the case.

The *first pair*, are composed of three nearly cylindrical joints, the first two of which are very similar in size, and the third about one half the length of the preceding. The basal joint has a short movable hairy seta at its apex, and another on its posterior margin; also a very short jointed appendage on the same margin near its extremity. The second joint has a similar seta near its apex and is ciliated on its posterior margin. The terminal joint is furnished on its posterior margin with three long finely ciliated setæ, or pinnulæ, whose length about equals the preceding joint of the leg. The ciliæ are very short on the outer side of these pinnulæ; but of the usual length on the inner. At the apex there are four short obtuse naked setæ. The *sternum* to which this pair of legs is articulated, is very narrow and terminates on each side in a process lengthened posteriorly for articulation with the legs.

The *second pair* of natatories are composed of five stout compressed joints, with a large tri-articulate appendage to the second joint. The basal is very short, and has on its posterior margin a curved pinnula, which extends over the median line. The second joint is very large and increases in size from its base to its apex. There is a short seta near its posterior margin, and another near its apex. On its posterior edge there is a broad membrane, exceedingly thin and transparent, and finely striated like the margin of the shell.

The *appendage* to this joint arises from the inner part of its extremity, and curves backward and inward. It is provided with seven long pinnulæ, which in general, extend with a curve to the median line of the body; the first joint has one of these pinnulæ, the second two, and the third four. These joints are mostly very flat. The first joint is short and very similar in form to the basal joint of the leg. It is furnished exteriorly with a broad plate, which is ciliated at its apex. The second joint of this appendage, is smallest at its base, and increases with a curve to its apex, which is rounded. Its outer margin is ciliated. A shallow concavity receives the apical joint, which is small and nearly semicircular.

The remaining joints of this leg, are also furnished with seven long natatory pinnulæ, of which one appertains to the third joint of the leg, one to the fourth, and five to the fifth. The third joint is broad and oblong, and is ciliated on its inner margin. A large stout spine, with a thin corneous expansion on two opposite sides, is articulated with the apex of this joint. The fourth joint is shorter than broad, and has a small spine at its apex. The terminal has nearly equal length and breadth, and is obliquely truncated at its extremity. There are two short spines at its apex. The pinnula terminating this joint, is provided with ciliæ only on its inner margin. The other margin is furnished with a thin membrane, which extends from the apex, to an enlargement in the seta near its base.

The sternum uniting the legs of this pair, is quite large; its breadth is one third its length. The posterior margin is somewhat fleshy and thin, and provided with a delicate membrane, whose breadth is nearly as great as that of the sternum. The anterior articulating margin of this sternum is firm and osseous. The adjacent teguments with which it is articulated are similarly ossified, and supported both before and behind by two strong osseous processes, situated in the teguments. The anterior processes are short, and terminate in a curve between the two sternums. The posterior are nearly three times the length of the sternum;

they diverge from their insertion and extend to the base of the apron, (fig. 18.) Here they are united by a slender osseous process, which forms the upper limits of the sternum of the apron. They continue on, making at first one or two irregular curves, and form also the lateral boundaries of this sternum. By this remarkable arrangement, the articulation of the sternum of the large natatory legs is rendered sufficiently firm for their powerful action in the motions of the animal.

The *third pair* of legs has been already stated to be expanded into the form of an apron, forming a broad lamellar appendage to the cephalo-thoracic portion of the body. This apron is composed of the same parts as the natatory last described, and there is an almost perfect coincidence in the number and nature of the appendages.

The sternal piece is very wide and lamellar. On its posterior margin there is a broad membranous expansion, identical in structure and position with that appended to the preceding sternum. The portion of the apron corresponding to the small first joint of the natatory leg, is very narrow, and has very imperfectly defined limits; we see an indication of its presence in the single pinnula, behind, adjacent to the sternum.* The second joint is expanded into a broad, irregular trapezoidal figure, with concave sides excepting its posterior margin. Like the same joint in the natatory, it is furnished with a broad thin membrane posteriorly, and a jointed appendage provided with pinnulæ. The first joint of this appendage is quite small, and bears a single pinnula as in the perfect leg; the remaining portion is circular and is furnished with six pinnulæ. We find the analogue of the third joint of the natatory in a broad nearly circular plate, which is the lateral termination of the apron; it is connected with the basal portion by an indistinct suture. The posterior margin of this joint, like the same joint above, bears a ciliated leaf-like expansion. The analogy of the parts is still farther apparent in the strong articulated spine and pinnula attached to this joint, and in the two small terminal joints, furnished with pinnulæ; the first with a single pinnula and a spine at its apex, and the second with four pinnulæ, and two short apical spines.

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* The corresponding parts of the apron, and the second pair of natatories, are indicated in the figure by the similar numbers in them.

4. *Posterior Thoracic Segment.*—The legs attached to this segment arise from the posterior part of the lateral surface. They are composed of four joints, which gradually diminish from the base to the apex. The basal joint is large, nearly cylindrical, and irregularly rounded at each extremity; there is a short hairy seta at its apex. The second joint is scarcely half the diameter of the preceding. It gradually diminishes to a pointed apex, furnished with a curved spine. The third joint is flat, and is articulated, by its obliquely truncated base, with the inner side of the preceding joint. There are two long setæ on its inner apex, which are edged on two opposite sides with a pectinated membrane. There is a short pectinated appendage, projecting like an epaulette over the base of each of these setæ, and also over the articulation of the following joint. This terminal joint is long, slender, and setiform. It has a row of short spines along its inner edge.

5. *Abdominal Segments.*—The anterior abdominal segment is entirely destitute of any articulated appendages. Posteriorly, on each side, there is a broad lamellar sub-triangular organ, which, in the male, is much elongated, while in the female, excepting young individuals, it is very short.

The appendages to the terminal joint have already been described.

*Change of Skin.*—But few facts have come under our observation respecting the change of skin; these few, however, appear quite peculiar and worthy of remark.

When the time for shedding the old skin approaches, the internal membrane, which is to form its new envelop, is very variously folded into ridges throughout the whole body. In some parts, the ridges or folds are situated around the bases of the muscles, and enclose regular areas. These folds continue increasing in size, till the time of moulting. This process produces a singular arrangement of the *anterior* portions of the inner shell, or, we may say, inner animal, as it affects the form of the included parts. The centre of the front margin of the internal shell is drawn inward and backward, as represented in fig. 23, Pl. V, in which c d represents the outer margin, and c′ n d′ the corresponding edge of the inner shell, e f the articulation in the old shell, and e′ m f′ the corresponding articulation in the inner.

These folds undoubtedly result from an increase of the animal within a shell too small to admit of its expansion. The internal members, like those of animals having a soft skin, appear to increase in actual quantity of matter, as rapidly when enveloped in their unyielding corneous covering, as in their new membranous envelop.

There is a remarkable fleshy appendage to the anterior portion of the soft internal animal, the importance or functions of which we are unable to explain. It is represented at m n, fig. 23, in its natural position. It lies wholly external to the inner shell, and is attached only at o, its anterior extremity. Figure 24 is a profile view of this appendage; similar letters mark the corresponding parts in the two figures. After separating the outer skin, it may be drawn forward into the position in fig. 25. In one instance, we found an animal with this singular appendage, in front, presenting very much the appearance in fig. 25. It was, however, composed of three of these appendages, m n, placed end to end, and appeared to have undergone three successive moultings.

In external appearance, this organ very much resembles a muscle, as it is striated, like them, though very coarsely. It is probably attached, by its large extremity, to the outer shell.

## II. MUSCULAR SYSTEM.

The muscles moving the several members, may, in general, be distinctly seen and traced to their insertions through the pellucid covering of the body. Yet, under a magnifying power of five hundred diameters, we have not succeeded in detecting the ultimate fibres as given by Straus. With a much lower power, however, we have observed that all the muscles appear transversely striated, and by means of this important character, have been enabled to distinguish the nerves from the muscles, which, without this aid, would in many instances have been difficult or even impossible. These striations are most distinctly seen in the flat, simple muscles; those composed of several bundles of fibres, which is the case with many of the large muscles on the back, exhibit it, but less perfectly. We have examined the muscles of the common lobster, (Astacus marinus,) and have found these striæ in some instances, though with less distinctness. These striations vary much in their fineness. In general, they are from $\frac{1}{7000}$ to $\frac{1}{5000}$ of an inch apart. In some muscles, among which we may mention those elevating the buccal mass, we found them as coarse as $\frac{1}{3000}$ of an inch. We have conjectured that they are the result of minute folds in the muscular fibres; but we have been unable to detect an approximation of these striæ, or any alteration in their appearance, during the contraction of the muscle: this, however, may be owing to their extreme minuteness.*

On account of the very peculiar forms and motions of some of the organs in this animal, it contains several muscles of very unusual character. We reserve the description of them till these organs come under consideration.

a. *Muscles of the Segments of the Body.*

The first cephalic segment is flexed by two short slender muscles on each side, (R, R′,) situated just exterior to the process which forms the articulation of this segment, (figs. 1 and 7,) and directed backward and outward. They unite in a common short tendon. They act in depressing this segment, and assist in attaching its cup and anterior margin. This margin is provided with a narrow ridge, which is striated or wrinkled transversely, like the cup, and is apparently intended to produce a closer attachment of this margin.

For the mutual motions of the cephalic and thoracic segments, there are three pairs of muscles situated in the former, two attached near the median line, and one pair laterally. A pair of short muscles (I, I, fig. 7) run nearly parallel with the median line; they produce the slight flexion admitted at this articulation. Another pair of muscles, long and large, (S, fig. 7,) are situated on each side of the preceding; they pass obliquely outward. In addition to aiding in flexion, they produce a lateral sliding motion, often observed between these segments. A third pair (K, fig. 7,) also assist in flexion. The large muscles, (K′,) situated in the posterior segment, appear also to pertain to this joint; but we are not fully assured that this is really their insertion.

The extensor muscles of the posterior thoracic segment, and of the abdomen, arise adjacent to the median line, near the centre of the anterior thoracic segment. Three pairs of muscles are attached at this point. The outer (L) pass obliquely outward and

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* Since writing the above, we have found that these striations have been observed by Dr. Hodgkin in the muscles of man. He says: "Innumerable very minute but clear and fine parallel lines, or striæ, may be distinctly perceived, transversely marking the fibrillæ." These observations have led Dr. Hodgkin to doubt the globular constitution of the contractile fibre. We have also observed them distinctly in some of the Arachnides.

are inserted near the apex of the thoracic joint. The two pairs (M, N,) appear to continue through the thorax, to the last joint of the abdomen. Another pair of muscles (O) commence in the thoracic joint, near the median line; they pass obliquely outward to a point in the first abdominal segment, just below its centre, where they are inserted into the teguments. Another pair of slender muscles (P) arise near the insertion of the last, and pass to the following segment.

The flexor muscles of these segments, situated along the venter, are remarkable for having but two anterior attachments, although, counting the several insertions in the posterior segments, there appear to be six distinct muscles. Two broad muscles arise on each side of the medial line opposite the prehensile legs. As they pass between the sternums of the natatory legs, they divide into three portions as represented in fig 5 a, Pl. I. The large muscle here suddenly contracts in size, and afterwards continues on, much diminished in volume; exterior to this continuation two muscles are attached, each by a tendon, to the diminishing portion of the main muscle. Though apparently distinct, these three muscles continue connected, and pass on beyond the sternum of the second pair of natatories, where there is a second subdivison of the muscle. We observe an oblique constriction of the whole, (fig. 5, b,) below which, the three muscles are continued of nearly their former size, and a fourth is added, exterior to the three. Thus divided, the muscle continues into the abdomen, where the four parts are separately inserted: the exterior pair diverge and are attached near the base of the abdomen; the interior, are inserted below the centre of the abdomen, directly under the insertions of the extensor muscles of the back; the two remaining pairs are continued into the terminal abdominal segment, the outer passing beyond the centre of this joint. Another pair of small muscles are inserted in the base of this joint, which arise near the attachment of the interior pair of abdominal muscles.

The other set of muscles, consisting of two pair, arise a short distance below the sternum of the posterior natatory, exterior to the muscles just described. One pair, the outer, is inserted in the base of the thoracic joint, and the inner, laterally below the centre of the abdomen.

The lateral motion of these joints is produced by the simultaneous action of the flexor and extensor of the same side. The insertion of the more powerful of the abdominal muscles below the centre of this segment, in preference to an attachment near its base, enables the animal to give this segment great flexion. When the animal has been attached to the glass out of the water, we have often separated the anterior portion of the body from the glass, till it formed an angle of 75° or 80° with the abdominal portion, and generally the animal has succeeded through the action of these muscles in restoring its head again to the glass.

The muscle (O) on the back may possibly be attached to the muscle (N) and not to the thoracic segment. We have not succeeded, in our dissections, in exposing these muscles in order to determine this point.

b. *Muscles of the organs appertaining to the several segments.*

1. *Anterior Cephalic Segment.*—In the following account, we shall in general describe only the muscles moving the basal joints of each of the legs. More minute particulars may be obtained by reference to the plates.

The muscles moving the cup, have not been satisfactorily determined. A slightly elevated line passes from each side with a curve into the membrane of this organ, which may be muscular; if so, they act in flattening the cup preparatory to its attachment.

The antennæ have two extensors and one flexor. The two extensors are inserted in a tendon, occupying the anterior margin of the base. They extend half way to the eyes; one (a, fig. 7 and fig. 1) above the flexor of the anterior cephalic segment, is attached to the upper shell; the other, (a′, fig. 1,) much the smallest, passing under the same muscle, is attached below. The flexor (b, figs. 7 and 1,) is inserted near the outer part of the base, by means of a short tendon, and is attached near the base of the preceding muscles. These organs have but little motion, and are seldom observed in action.

2. *Posterior Cephalic Segment.*—The elevators of the *buccal mass* are four short narrow muscles, inserted in the bony processes, g, (figs. 12 or 17,) and attached to the teguments below, under the anterior extremity of the mouth; the insertion of one is exactly posterior, and of the other, a little lateral, as is represented in fig. 17. By means of these muscles the buccal mass may be elevated to a right angle with the surrounding parts. On dying, the mouth is often left in this elevated position. A muscular band passes across the back part of the buccal mass and after

attaching itself to the curved process, f (fig. 12,) on each side, continues on, and is inserted in the shell. At c, (fig. 7,) near the eyes, we observe the attachment of a pair of muscles which are in action when the buccal mass moves; we have not detected their insertion, but suppose from their position that they act in depressing it.

The internal parts of the mouth which receive distinct muscles are as follow: the upper lip, the mandibles, and the parts of the inner mouth. The upper lip is provided with two pairs of retractors which are attached near the centre of the exterior membrane of the mouth. The interior pair are very slender; they are inserted in a minute process near the extremity of the lip, (fig. 15,) and move merely the extremity, giving it the position in fig. 16. The exterior pair are four times the width of the interior; they are inserted near the middle of the lip and retract this organ nearly to the bony arch.

The mandibles are provided with muscles of extraordinary length and power. There are two pairs connected with the same slender bony tendon, the one with its extremity, and the other with its posterior side. The former, (d, figs. 1 and 7,) pass outward and a little downward, and on approaching the apex of the basal joint of the third pair of maxillipeds, curve suddenly backward; they are finally inserted in the margin of the shell opposite the articulation of the head and thorax, after having run over a space equal to one half the whole length of the cephalo-thoracic segment. The other pair extend obliquely backward and outward under the base of the rudimentary feet. Although these organs are provided with such remarkable muscles, they are very confined in their motions. They occasionally have a vibratory motion when the animal is nearly exhausted, and this is the only action we have observed. Their position and the form of the adjacent parts satisfies us that their extremities cannot be projected out of the mouth; and probably they can scarcely reach the opening between the lips.

On account of the thickness of the enveloping membranes, and the difficulty of dissecting the internal parts of the buccal mass, we have not discovered the muscles moving these parts. We can only specify one pair of slender muscles, which are inserted in the lateral portions of the process g, (fig. 17.) It is the retractor of these processes, and through them opens the folds which close the esophagus, by means of a tendon inserted in the lower extremity of these folds.

The basal joint of the *first pair* of *maxillipeds* has but little motion. There are two short muscles, elevating or depressing the extremities of this joint, which we may consider a flexor and an extensor. The flexor, which is inserted near the interior extremity, is directed backward and a little outward to its attachment to the lower shell, exterior to the base of the following pair of feet. The extensor is inserted at the posterior margin of the joint, and extends obliquely inward, approaching the attachment of the flexor. In the female these muscles have nearly the same position as in the male (fig. 18 a;) the flexor is inserted near the spine on this joint. The united action of these muscles draws the anterior margin of this joint from the shell. To oppose this motion there is a large muscle inserted near this margin and extending one side below the eyes, (e, fig. 7,) where it is attached to the back shell.

The extensor of the second joint of this pair of legs is a long broad muscle attached to the shell above the large curved spine, (f, fig. 7.) There is a small flexor of this joint, attached to the posterior apex of the basal joint.

The rudimentary feet, or *second pair*, are provided with but few small muscles, requiring no remarks.

The *third pair* are remarkable for having as various motions as could be afforded by a ball and socket joint. This arises from their insertion on a fleshy prominence, composed probably of the rudiments of the small basal joints in the corresponding organs of the higher crustacea. To produce these various motions, each leg is provided with five muscles radiating from the base, some of which are of very peculiar form. Four of these muscles are inserted into the base of the first joint and one along its posterior margin. The latter appears to be attached to the back near the median line, a short distance behind the eyes, (g, fig. 7.) Of the remaining muscles, two pass forward and outward, (h, i fig. 1 and fig. 7,) one directly outward, and the fourth, (k, fig. 7,) backward and outward. The most anterior (h) is a slender muscle, attached just exterior to the base of the first pair of maxillipeds. The second (i, fig. 1 and fig. 7) is composed of two parts inserted into the same tendon. These parts continue together through half their length, then separate, and soon after each divides into two nearly equal portions, which diverge under the large curved spine and pass to their attachment at the margin of the shell.

The base of the *fourth pair* of maxillipeds has a narrow prolongation, which affords attachment to two muscles; one passes posteriorly, and is attached near the articulation of the head and thorax, (m, fig. 7,) another extends outward in front, beneath the extremity of the adjacent spine. Two other short muscles are inserted at the base of the prolongation, and are also attached near the spine; one on the back, and the other below. The last of the muscles moving this pair of legs, extends outward and is attached to the epimeral articulation, (l, fig. 7.)

The terminal claw is provided with flexor muscles of great strength. A large conical muscle attached along the whole posterior margin, is inserted in a bony tendon extending from the inner portion of the base of the claw. Another large muscle arises from the basal portion of the joint and is inserted into the preceding muscle a short distance from its insertion. There is the same arrangement in the female, (fig. 18 b.) A small extensor is inserted in the outer part of the base of the claw and attached to the outer posterior margin of the first joint.

3. *Anterior Thoracic Segment.*—The two legs of each pair of natatories, have been described as simultaneous in their action, which consists in their rotation with the included sternum, on their anterior margin.

The principal elevator of the *first pair* of natatories is a large digastric muscle. This muscle occupies the space between the basal joint of these legs and the preceding pair. It is composed of four muscles which unite in a common tendon; this tendon passes under a curved osseous process, by which it is confined in its place, and is then united to another bundle of muscular fibres inserted in the lower surface of the leg. The depression of these legs is produced by a long muscle which is inserted in the joint near its base; it is directed forward and outward, passing under the digastric muscle beyond the articulation between the head and thorax, and is attached to the epimeral articulation (n, fig. 7.) This pair of legs, though thus provided with muscles of considerable strength, is seldom used by the animal in effecting its motions.

We have already seen that the *second pair* of natatory legs are well adapted to form powerful propelling organs; that the flabelliform arrangement of their pinnulæ, the attachment of these pinnulæ to two distinct articulated branches, added to the flattened form of the joints, give the oars a broad expanded surface for action on the water in swimming. They are farther fitted for this object by the provision of a large number of powerful muscles, which occupy nearly the whole of the thoracic segment.

Inserted in the anterior part of these legs, there are three large muscles attached to the back shell, two of which (o, p, fig. 7) arise on the median line—a third (q) at the articulation between the head and thorax. Four powerful muscles are inserted in its posterior margin; the three outer (u, t, s,) pass backward, and are inserted in the posterior and medial part of the segment above. The fourth (r) is attached to the back shell over the anterior part of the base of the leg, near the medial line of the body; it first passes inward and backward, then curves outward around the base of the muscle adjoining, (s,) and finally extends upward to the posterior margin of the leg. The circular form of this muscle is so very extraordinary, that we at first doubted its muscular nature. We have however assured ourselves of this fact by frequent dissections. Two other short muscles with converging fibres, (w, v,) arise laterally from a broad base in the epimeral articulation, and serve to retract the leg to the shell. These muscles probably cooperate with the posterior, in the depression of the leg.

If these oar-like legs struck the water with the same broad expanded surface, in their backward motion, as in their forward propelling action, the animal would advance but slowly, if at all; for the latter would be counteracted by the former. There is a provision against such a defect, in the muscles moving the several joints of these legs, by the action of which, the terminal portions receive a partial revolution, and cut the water, when drawn backward, by their thin anterior edge. Their special adaptation for this purpose is apparent, even in the pinnula terminating the leg, which instead of being ciliated on both edges, is furnished anteriorly with a thin membranous expansion.

These legs appear to be the only organs for walking as well as swimming.

The principal extensors of the *third pair* of legs, or the *apron*, are four in number; two (y, z) arise on the back near the medial line, and pass laterally to the outer insertion of the apron. One of the remaining two, (x,) arises just above the posterior sinus, and the other from the inner margin of this sinus; both are attached on the back, and inserted near the articulation of the sternum. The flexor muscles arise below, just outside the apron, and occupy the greater part of its interior. A single muscle is attached near the articulation of the sternum, and passes into the basal portion.

This apron, appended to the cephalo-thoracic segment, forms the anterior portion of the body into a large, broad cup, which is perfectly closed, with the exception of a small opening at each of the posterior sinuses. These we have already described as provided with a folded membrane, furnished with muscles capable of drawing it over and completely shutting the opening. The membranous margin of the animal near the antennæ, has also a fold by which a small leak, if it be such, is closed. Considering these several provisions, it is probable, that the whole of this anterior portion of the animal is especially adapted to enable the animal to attach itself firmly during the rapid motions of the fish, and that the small marginal cups in front are relied on, only while the fish is stationary, or but slowly moving.

The remaining pair of legs are moved by short slender muscles, and seem to possess little power. They usually hang loose and motionless while the animal is swimming, and when attached to the body of the fish, are commonly extended by the side of the abdomen.

## III. NERVOUS SYSTEM.

### a. *The organs of the senses.*

The only organs in the Caligus, which we have been able to distinguish as the undoubted residence of special senses, are the eyes and the antennæ. The latter organs have already been described; it remains to explain the structure of the eyes.

The *eyes* are wholly *internal*, and are situated near the centre of the posterior cephalic segment, directly over the lower part of the buccal mass. They are two in number, simple in their structure, and placed near one another, on a single reddish-black ground. They project from each side of this colored ground, with a spherical surface, somewhat exceeding a hemisphere. On dissection we readily distinguish the following parts.

1. A *cornea*, which is thin and transparent and forms the spherical surface of the eye:

2. A *lens*, simple, spherical, and distant from the cornea; its diameter is about half that of the cornea:*

3. A colorless, transparent fluid, which we presume to be the *aqueous humor*, occupying the space just within the cornea:

4. A deep red, nearly black *pigment*, which forms the colored spot supporting the eyes.

We have not observed the vitreous humor. In the spherical form of the lens, the eyes resemble the same organs in fishes. They are not movable, and have no connections except by the optic nerve. The adjacent parts are transparent, enabling the animal to see in both directions. We have already described the shell above, and referred to its representation in fig. 8, Pl. IV. It is perfectly flat, without any spherical projection, corresponding to that of the cornea within. The translucent elongated space in fig. 8, lies in the shell, and passes over the space between the eyes.

b. *The nerves.*

The nervous system contains but two ganglions, and these by their close approximation appear at first, to compose but one. They are situated directly behind the eyes, the one above the esophagus, and the other below it, and are so intimately connected on each side of this portion of the alimentary canal, that it has been found impossible to separate them, (fig. 20.) Indeed, it would scarcely convey an incorrect idea of the *form*, to describe it as a single mass, with a longitudinal cavity through the centre, for the passage of the esophagus. The size of the united ganglions is rather greater than that of the buccal mass. The nerves arising from these ganglions are flat, fibrous cords, enclosed within a membranous envelope or neurolemma. This neurolemma is often one fourth wider than the bundle of nervous fibres contained within, and these fibres appear to pass through without any attachment. The neurolemma is sometimes slightly folded, which gives a crenated appearance to the margin of the nerve.

The *brain* or cephalic ganglion has a broad ovate or sub-cordate form. It gives off three pairs of nerves.

The first pair, (a fig. 20, Pl. IV,) leaves the central part of the anterior margin and passes directly to the eyes. As the eyes are adjacent to the ganglion, these nerves are very short.

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* The lens in the simple eyes of crustacea is usually described as being in immediate contact with the cornea: it was very evidently distant from this membrane, in the Caligus.

The second pair, (b fig. 20,) arises from the same margin laterally, and extends upward towards the cup, (fig. 18,) passing just within the articulating process of the cephalic segments. It gives out large branches which are distributed to the surrounding muscles and teguments. The anterior extremity which goes to the cup is scarcely one third the size of the base.

A small hollow vessel, (fig. 18,) extends from the organs which we have considered analogous to the inner antennæ in other crustacea, along the median line, and appears to terminate in a bulb, about half way to the brain. This vessel has been the subject of much investigation, without removing all the doubts respecting its nature. When separated from the body, it appears to be a large neurolemma, containing two small bundles of nervous fibres, and this is our final conclusion, though adopted with some hesitation. It appears probable, from the result of some of our dissections, that this bulb receives a nerve from each side, which either arises directly from the brain, or, is a branch of the nerve last described. If this is a distinct pair, it corresponds to the *third*, or inner antennary pair in the lobster, as given by Edwards, and the pair described as passing to the cup, and surrounding teguments and muscles, is the analogue of the *fourth* pair, which has a similar distribution in the lobster.

The remaining pair of nerves, (c,) arise from the anterior angles of the brain, and pass to the antennæ; they are one half larger than any other in the body. Near the origin, they give off exteriorly a slender branch, which continues nearly parallel with the main nerve, and passes to the muscles of the antennæ. Without farther branching they extend in nearly a straight line to the base of the antennæ, where they subdivide into four large branches, which are distributed to the fleshy papillæ, (fig. 19, Pl. V.) Two nerves from the posterior branch run along the muscles, and are continued into the terminal joints, one to each of the two terminating sets of setæ. The antennæ are so abundantly furnished with nerves, that they must be the seat of an important sense. The sense of touch is the only one for which their peculiar form, and their delicate papillæ, appear adapted.

The thoracic ganglion, which is composed of all the thoracic and abdominal ganglions united, has a cordate form, and is somewhat larger than the brain. Its inferior extremity extends rather farther beyond the brain, than the brain beyond it in front. This ganglion gives off seven pairs of nerves in front and laterally, and two pairs behind, besides a central nerve or the spinal cord.

The first two pairs originate at the centre of the anterior margin, (d, e, fig. 20.) The inner is quite slender and appears to enter the mouth each side of the esophagus. The second has twice the diameter of the first; it curves more outward, and is supposed to go to the mandibles and their muscles. These nerves pass under the buccal mass, and cannot be traced while it is in its natural position. They invariably appear broken off when the buccal mass is removed; and sometimes after detaching it, a nerve equal in size to the first, has been seen entering the mouth near the esophagus, as above stated. These facts have been deemed sufficient to authorize the above opinion respecting the destination of these nerves.

The *third* pair (f, fig. 20) arise from the anterior angle of the ganglion. They give out a branch exteriorly to the muscles of the first pair of legs, and afterwards continue to these organs, and pass into the terminal joints after giving a branch to the basal.

The *fourth* pair (g) arise just posterior to the last, and are distributed to the outer teguments. They afford a branch near their origin, which probably passes to the rudimentary legs: soon after they divide into two parts; one branch passes outward and a little forward towards the curved spine, and subdivides into four branches before reaching it, which are distributed to the neighboring teguments; the other branch, extends backward to the epimeral articulation, just below the articulating processes, where it passes to the epimeral segment; it then branches, and is distributed to the various parts of the inferior portion of this segment.

The *fifth* pair (h) arise from the lateral margin of the ganglion, some distance behind the preceding. They give off a slender branch near their origin, and pass along with the branch to the third pair of maxillipeds.

The *sixth* pair (i) arise near the preceding, and are large nerves. They divide immediately, and then subdivide into several branches, which are distributed to the fourth pair of maxillipeds, and their muscles.

The *seventh* pair (k) originate near the last, soon divide into two branches, which pass to the muscles of the same legs. They are slender nerves.

These seven pairs appear to correspond to those of the first thoracic ganglions in the macrural crustacea. The remaining nerves pertain to the thoracic legs, and the abdominal portions of the body.*

The outer pair (l) belong to the anterior natatories. They continue parallel with the spinal cord till they reach the furcate process on the venter; they then curve outward, exterior to the ventral muscles, give off three branches in succession from the outer side, to the muscles of the first natatory. Before entering the basal joints of these legs, they divide into three portions, which enter together; the inner branch is quite slender, and passes to the posterior movable seta, and the jointed appendage; the middle is distributed to the muscles of the basal joint; the outer branch gives a slender nerve to the apex of the basal joint, and then passes to the two following joints, dividing as it enters them. We refer for minuter details to figure 18, Plate V.

This pair of nerves give off a slender branch near their origin, (r, fig. 20,) which passes to the attachments of the stomach.

The next pair of nerves (m) are distributed to the second pair of natatories. They diverge from the spinal cord—to which they are adjacent—below the furcate process, and soon give off a branch interiorly, which passes down the venter, and appears to be distributed to the ventral muscles. As they approach this pair of natatories, they give off another branch from the same side, which also passes backward, and is supposed to furnish nerves to the posterior muscles of these legs. On entering these natatories, the nerve divides into two branches, the upper of which soon gives off a third; the inner nerve, as in the preceding legs, goes to the posterior seta, and the articulated appendage; the middle furnishes the basal joint, and sends a branch into the terminal; the outer affords a small nerve to the seta at the apex of the basal joint, and then passes into the extremity of the leg.

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* The apparent correspondence of these nerves, with those of the first thoracic ganglion in the higher crustacea, together with the great similarity in the last two pairs, to those which are distributed to the posterior pair of maxillipeds in the decapodous species, (see Edwards's Hist. Nat. des Crustacés, T. I. p. 137) have induced us to adopt the designations heretofore employed in speaking of the organs of this segment of the body, in which we consider the three posterior pairs of cephalic legs as the anologues of the three pairs of maxillipeds in the typical species. The only objection which can be urged to this view, arises from there then being but *four* pairs of thoracic legs. This objection will however be removed if we may consider the furcate bone on the venter, just anterior to the first pair of natatories, as the rudiment of the sternum of a fifth pair, which view is favored by its position, and its resemblance to the sternums of the following pairs.

If this conclusion is correct, the twenty-one rings, the *normal* number constituting the body, may be considered as distributed in the following manner:

The *anterior cephalic* segment, includes the second and third, as the first—the ophthalmic—is wanting. The *posterior cephalic* segment, contains the following six, corresponding to the mandibles, (fourth,) and a pair of maxilla, (fifth,) in the buccal mass; and the four pair of feet attached to this segment. The *anterior thoracic* segment will include the tenth, eleventh, twelfth and thirteenth rings, to which the furcate process, the two pairs of natatory legs, and the apron, pertain. The *posterior thoracic* segment, is the fourteenth ring. The remaining seven rings, the abdominal, constitute the terminal portions of the body; some of these last may however be wanting.

This pair of nerves give off a branch exteriorly near their origin, (s, fig. 20,) which curves outward under the furcate process, (s, fig. 18,) *beneath* the ventral muscles, gives a nerve to these muscles, and is then distributed to the anterior muscles of the second pair of natatories, and to the adjoining teguments. Its branches may be seen at s′, s″, fig. 18.

The spinal cord, furnishes the nerves to the remaining members. It appears to be composed of two parts near its origin, but there is no division till it has passed beyond the sternum of the second pair of natatories. Previous to this division, a short distance below the sternum, this spinal cord gives off from each side a large nerve which goes to the apron. These nerves are seldom exactly opposite in their origin; as is also the case with the nerves, r and s, fig. 20.

The nerves to the apron, just before entering it, give off a branch exteriorly, which is distributed to the outer portions of the apron, or more properly its terminal joints. Soon after entering the apron the main nerve again divides, and one branch is distributed to the basal part, and the other to the muscles of the following portion of the apron.

The spinal cord, after giving off the nerves to the apron, soon divides. Thus divided, it gives off a pair of nerves to the remaining thoracic legs, and on entering the abdomen, furnishes a pair of nerves which branch in this segment. It thence continues to the last segment, and distributes fibres to the terminal portions of the body.

## IV. NUTRITIVE SYSTEM.

### a. *Organs of digestion.*

The alimentary canal, (fig. 9, Pl. V,) is composed of three distinct parts, corresponding to the esophagus, the stomach and the intestine.

The *esophagus* constitutes one sixth the whole length of the alimentary canal, and in large individuals is about one sixteenth of an inch long. It extends in the form of a long slender tube of uniform diameter to the stomach, and passes a short distance into its cavity. Its insertion in the buccal mass may be seen in fig. 17, which is an under view of this organ. The anterior opening is closed by two fleshy folds, which have already been described when speaking of the organs and muscles of the buccal mass. At its commencement, there is an oblong enlargement, (fig. 10,) longitudinally striated, which may be considered a pharynx. The communication with the stomach is closed, but whether by a sphincter or valve is undetermined. The peristaltic motion frequently seen in the stomach and intestine, never extends into the esophagus.

This portion of the alimentary canal is readily separated into two membranes. The inner, the mucous coat, is thin and transparent, and very smooth. The outer is much thicker, and scarcely semi-transparent; its muscular fibres are not apparent. When highly magnified, its exterior surface appears very uneven. If the mouth is detached from the body with care, the esophagus often continues attached to it, and presents the appearance exhibited in fig. 17. The inner coat is usually entire to its termination in the stomach, while the outer which is continuous with the exterior membrane of the stomach is invariably torn off, not far from the base of the esophagus, as in the figure.

The *stomach* has a broad cordate form, and is a little shorter than the esophagus, and when expanded is somewhat wider than long; vertically it is quite narrow. The anterior extremity lies between the prehensile legs, and posteriorly it extends under the furcate process on the venter. The lateral margin is very deeply crenated, owing to the peculiar arrangement of its muscles. The teguments of the stomach are composed of the same coats as the esophagus, and they present the same general character. The inner appears uniformly smooth and even. The outer contains several muscular bands, which connect the opposite crenations; in their contraction the crenations are rendered more prominent. These muscles are connected by other slender muscles irregularly arranged, which contract the stomach longitudinally. The lateral portions of the stomach are connected on each side with the shell adjoining, by ligamentous or cellular attachments, as is represented in fig. 9. There is no valve between the stomach and the intestine, and when the peristaltic motion is reversed, as often happens, the fluids frequently return into the stomach.

The *intestine*, at its commencement, is between three and four times the diameter of the esophagus, and about one fifth the diameter of the stomach. It is slightly enlarged below the second pair of natatories, where there are two pairs of glands, contracts again as it passes below the apron, and thence continues of uniform size to the rectum. Its structure is very similar to that of the stomach, both in its inner and outer coat. The arrangement of its muscles in regular bands is represented in fig. 11; during their action the canal is crenated as in the figure. The intestine is attached by distinct ligaments at several places; near the glands, d, and the glands, e and f, we have distinctly seen these attachments.

The *rectum* occupies the terminal half of the last abdominal segment, and is about one half the diameter of the intestine. Its communication with the intestine, is closed in the natural state of the parts. This rectum, if it may be so called, appears to have a longitudinal opening below, extending its whole length and its walls are usually in close contact. The external opening or anus is situated at its extremity.

This portion of the alimentary canal is opened laterally by seven pairs of slender muscles. The first pair at the extremity pass directly outward along the margin of the joint; the second are inserted near the extremity, and pass upward and a little outward. The following three pairs, are attached near the middle, and pass outward and a little upward; the remaining two pairs, are inserted near the opening to the intestine, and have the same direction as the last. The muscles have often been seen in action, in expelling the fæces; the two sides move either simultaneously or alternately, according to the necessity of the case, in the act of expulsion.

The intestinal fluids are usually light yellow; occasionally they present a deep wine yellow color, especially below the sternum of the second pair of natatories. Solid vermiform masses of a brown color, are often seen floating in the fluids.

Along the alimentary canal, there are several small glands, which have a granulous structure and are in general but slightly colored. Their particular functions, are mostly conjectural.

The central projection between g, g, fig. 12, is the termination of a gland of considerable size, which is situated beneath the posterior extremity of the buccal mass, and is usually detached with it, on dissection. It is represented in fig. 9, a, where its size corresponds to the mouth in fig. 9. When separated from the mouth, a duct may be seen on each side, entering the mouth near the esophagus. Anterior to the mouth, another collection of glands is observed, (fig. 9, b, see also fig. 1,) which also communicate with the mouth by ducts. These are probably salivary glands.

The esophagus, especially near its base, is furnished with a large number of exceedingly minute, transparent globules, supported on short pedicels, (fig. 10, Pl. IV.) These appear to be glands, and their pedicels ducts.

Below the stomach in the thorax, there are four pairs of glands. One pair of nearly spherical form, are situated at the lower extremity of the stomach, (c, fig. 9.) The second pair, larger, of an oblong form, (d,) occur just below the sternum of the first pair of natatories, and are connected with the intestine by a duct under the following sternum. The third and fourth pairs, (e, f,) are situated on the enlargement of the intestine, below the sternum of the second pair of natatories. The functions of a liver are probably performed by some or all of these glands.

Two other pairs of small glands are situated in the abdomen, which we presume to be connected with the intestine; we have not however distinguished their ducts, neither have we by dissections obtained more than one of them separate from the body. They are possibly urinary glands.

The Caligi have heretofore been supposed to live by sucking the blood of the fish on which they are found. It is however apparent from the structure of the mouth, that they are wholly unfitted for this mode of life. There is no organ which can perform the functions of a sucker. Moreover, we have never detected any blood in the stomach of these animals, although we have often examined them, immediately on taking them from the fish. On the contrary, the fluids always have a light color.

We have not fully satisfied ourselves of the nature of its food, but presume that it lives on the mucus which covers the body of the fish. The mucus is one of the natural secretions of the fish, and is always abundant. The organs of the mouth are well formed for the collection of it, and the free motion in the whole buccal mass seems peculiarly fitted for this purpose.

Several specimens of the Caligus, when confined on their backs in but a small portion of water, just sufficient to cover them, have been observed to elevate the buccal mass, and take in globules of air, which passed down the esophagus into the stomach, and thence through the intestine. Occasionally the globules of air have been so numerous and taken in such rapid succession, as to fill the stomach, and very much inflate it. In their passage through the esophagus they usually stop for a short time at the entrance to the stomach, indicating the existence of a valve or sphincter at this place.

b. *Circulation.*

The blood of the Caligus, as in other Articulata, is a limpid fluid, containing suspended in it numerous minute colorless particles. These particles are very various in their form and size. The smallest scarcely equal $\frac{1}{3000}$ of an inch. We have observed one particle the length of which was about $\frac{1}{150}$ of an inch, and its breadth $\frac{1}{4}$ its length; another had nearly the same length and a breadth equal to $\frac{1}{2}$ its length. These particles can accommodate themselves to the size of the passage through which the blood is flowing, becoming narrow and elongated if the passage is narrow, and again resuming their former proportions when they have reached a free open space.

The circulation in the Caligus is wholly lacunal; it appears to consist of broad irregular streams, passing through the spaces left among the internal organs, and in no part have we discovered distinct vessels. These streams have in general definite directions, yet are seldom uniform, continuous currents. They mostly advance by successive vibrations, depending on the palpitating action of the body. A single centre of circulation, or a *heart*, this animal can scarcely be said to possess. There are two points in the medial line where there is a valvular action, and each has its claims to be considered as performing the functions of this organ, though neither is entitled to that name. One of these systems of valves, the more perfect of the two, is situated in the apex of the posterior thoracic joint, (fig. 6 a, b.) There are at this place three distinct valves; two laterally on the back, situated in the dorsal currents which are flowing *towards* the tail, and one centrally below, giving passage to the ventral current flowing *from* the tail. The dorsal and ventral valves open alternately. Their action may be seen in the figures above referred to; a, represents the dorsal valves as shut, and the ventral open, and b, the dorsal relaxed or open, and the ventral shut. The action of these valves is very regular, and the currents which pass them are more uniform than those in other parts of the body. The number of palpitations has been found to vary from thirty to forty per minute.

The blood coming down the back* from the head, and also in two lateral currents from the point of intersection of the head, thorax and epimeral segments, (fig. 7,) passes the dorsal valves. It continues posteriorly; a part into the terminal joint of the body, and then up the venter, entering the ventral current at the extremity of the intestine; another part, into the same ventral current near the centre of the abdomen, and at other varying points. The ventral current passes through the ventral valve under the anterior margin of the apron, and continues up the body—washing, at the same time, freely over the intestine and stomach, to the thoracic ganglion, where it divides, and passes each side of this organ. Each of these branches goes off laterally; one portion (A) enters the adjoining prehensile legs, and returns down the body, uniting with another current which we shall soon mention; a second (B) passes a little forward and outward, gives off blood to the third pair of maxillipeds, continues outward, accompanies the muscles of the mandible, and runs down the body near its margin; a third (C) goes forward outside of the base of the first pair of maxillipeds, continues to the antennæ, to which it gives a portion of its blood, turns inward passing into the anterior cephalic segment, and along its articulation to the medial line. At this place the currents meeting from the two sides, flow down the medial line to the mouth.

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* The course is marked by arrows on figs. 1 and 7.

The *second* instance of valvular action occurs in this last medial current, between the second joints of the first pair of maxillipeds, (fig. 1.) There is a single valve, composed of a membrane, playing backward and forward, and thus preventing the return of the blood that has passed it. Between this valve and the mouth there appears to be a large cavity for the reception of the blood, from which it is propelled by a palpitating motion or powerful muscular action in the buccal mass, and surrounding parts. It acts in the following manner: the current enters through the valve while the posterior part of the mouth is elevated; the valve then closes, and immediately the buccal mass is brought down, and forces it out in a current on each side. This very extraordinary action is carried on uniformly, and is absolutely necessary for the flowing of the blood. Indeed, the blood flows *in* by the out-currents, until the action of the buccal mass throws it out. We presume that the depression of this organ is produced by the muscular band which has been described as passing across the posterior part of the mouth, to an attachment in the shell on each side, (fig. 12.) If the mouth be cut off, the blood flows out in a large free current, and the animal soon dies from exhaustion.

A current passes from this cavity each side of the mouth, and others on the back. One portion of the side-current unites with the current C, before described, of which it forms the greater part, and thus soon returns to the buccal cavity. Another portion flows outward, following the muscle of the mandible, and unites with B; this current, thus much enlarged, passes near the margin to the posterior extremity of the cephalo-thoracic segment, returns up by the epimeral articulation, crosses the same just above the junction of the head and thorax, and then turns suddenly backward; a part flows on the back, forming the lateral current on the back before referred to; the remaining portion below flows to the base of each of the natatory legs and the apron, and enters them, and at the same time and place, passes in part on the back; the current from the apron flows laterally down the abdomen.

Another portion of the side-current leaves the buccal cavity just along side of the mouth, unites with it, and flows to the base of the first pair of natatories. The union of these currents is somewhat peculiar: the blood vibrates upward on the venter, to a spot near the base of the prehensile legs, where a portion remains, although the main current vibrates back on the venter; at this moment, the current comes from the buccal cavity and carries the whole below.

The irregularity in the circulation in this animal is even greater than will be inferred from the above description. These currents are merely main directions; the blood flows into them or from them, through all their extent. The current coming laterally down to the base of the second pair of natatories, besides going into the natatory and on the back, is carried up the venter at each of the upward vibrations of the ventral current. The current from the apron also passes into the same current, in addition to its backward course. When it is considered that the currents of blood occupy merely the spaces left by the muscles and other internal organs, it will be readily seen that similar irregularities must occur in various parts of the body. These directions are occasionally subject to singular deviations. One of the two currents which run from each side in front, and unite on the medial line, has been observed to cross the medial line into the other current, and thus continue flowing for some time with considerable force; soon after, each flowed by vibrations towards the centre, but with alternate motion. This was observed immediately on taking the Caligus from the water, when it was apparently very lively. As the cod, however, had been for several days confined in the harbor near the market, all the specimens examined may have lost part of the activity usual in the open sea. At times, the blood in some parts merely vibrates back and forward, without advancing in either direction; and occasionally the blood flows in a direction exactly the contrary to its usual course.

We have not fully satisfied ourselves of the mode of respiration in the Caligus. The natatory pinnulæ—to which we must add those of the tail, as they are identical in their structure—have been supposed to supply the place of branchiæ. When the animal is attached to any object, these legs keep up a very regular action, which appears to correspond to the palpitations in the body.* We have not, however, observed the blood to flow into their setæ, and the currents passing into the legs are among the least regular. We are disposed to believe that these pinnulæ are not the special organs for this function, but that aeration takes place over the whole surface of the body. It is stated by Straus, that on separating the branchiæ of a lobster, the body absorbed nearly one half the oxygen usual before the removal of these organs. The thin envelop of the Caligus, and the extent of its external surface, must render its body a far more perfect substitute for branchiæ than the solid covering of the lobster. The vibrating action of the natatory legs serves to keep up a constant current of water, and thus affords continually a new portion to undergo the respiratory action of the body. It might be remarked that these legs, on account of their breadth, could not act so as to produce this current of water, when the whole margin around is attached. Probably the animal is not thus attached except when it is rendered necessary by the swift motion of the fish; under which circumstances, there is a sufficient current, without the action of these legs. We may presume that the special object of these marginal cups is to enable the animal to attach itself, and still keep the principal part of its body free, so that these natatory legs, when the fish is motionless, may have space to act, and sustain a continued current.

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* This action is not so rapid and branchial-like as in the Argulus, but takes place at intervals of about one and a half seconds.

### V. ORGANS OF REPRODUCTION.

On each side of the stomach, there is a large pyriform organ, (Pl. V, fig. 18,) of a glandular appearance internally, and provided with a distinct duct, which at first we unhesitatingly pronounced the liver. Subsequent observation proved that the duct, which we had supposed to enter the intestine, extends through the whole length of the thorax into the abdomen, where it is continuous, in the male, with organs known to be seminal, and in the female, with the egg-bearing vessels. These organs, thus shown to be connected with the organs of generation, have been since proved to correspond with the spermatic glands in the male and the ovaries in the female.

In the male, they are rather larger than the buccal mass, (Pl. V, fig. 21,) and are situated just anterior to the stomach, in part beneath the base of the prehensile legs and the spine of the preceding pair. Their small posterior extremity is produced into a short ligament, by which it adheres above the stomach; the anterior portions are so enveloped in their cellular or membranous attachments, that they are separated with great difficulty. In general appearance, it resembles a pyriform membranous sac, with an internal granulose structure. The duct, which is attached on the outer margin, is a slender vessel, of a thin membranous nature. It continues of a uniform size through the thorax to the central parts of the abdomen, where it gradually enlarges and undergoes a few convolutions.

A short distance below the convoluted portion, there is a small oval gland, with well-defined limits, contained within a distinct sac. It is apparently composed of several concentric parts, of which three are very apparent; there are two less distinct. Its interior is a transparent globule; the outer coats are less transparent, and the one adjacent to the interior, the least so. The central part of this gland is connected with a small sub-corneous tube, which gradually enlarges, and passes into the anterior extremity of the above convolutions. On one occasion, when we had separated this gland and its duct from the abdomen, a fluid, containing particles similar in appearance to those in the blood, rapidly poured out. The convoluted vessel appears therefore to receive the secretions of two seminal glands, and probably corresponds to the vas deferens. Though much time has been employed in searching for the exit of the vas deferens, we are yet uncertain on this point. It is presumed, from the appearance of the parts, that it terminates either on the outer surface of the lappet at the extremity of the abdomen, or beneath this organ.

The ovaries in the female have the same situation and attachments as the spermatic gland in the male. (Pl. V, fig. 18.) They are however much larger, and extend above the stomach nearly to its centre. They may be distinctly seen through the back shell. They appear to contain a long convoluted vessel, which gradually diminishes in size, from its anterior to its posterior extremity; but whether this be truly its nature, cannot be determined. The duct arising from its margin, extends without any variation in its size, till it reaches the posterior joint of the thorax, where it enlarges gradually, and continues to increase as it enters the abdomen. In the gravid female, it passes through the abdomen, with a few convolutions, and extends out at the vulva, in the form of a long, whitish, nearly cylindrical membranous tube. This external portion of the oviduct is often a little longer than the animal.

The vessel in the ovary does not appear to contain divisions indicating the presence of eggs; but the oviduct usually contains eggs through its whole extent. Where exserted, it is very distinctly divided by membranous partitions into narrow compartments, each containing an egg, though not quite filled with it. The eggs in the anterior slender portion of the oviduct are oblong and uniformly transparent. As they increase in size, they present a clouded appearance, and become divided into two parts, corresponding to the *white* and the *yolk*. The latter appears clouded and composed of albuminous globules. The several portions are represented in the exserted portion of the oviduct, (fig. 18.) The eggs have the form of short cylinders with rounded edges.

In the advanced eggs, at the extremity of the ovary, we observed in one instance, that there were two distinct eyes at their outer extremity; they were approximate, but not situated on the same black ground. In these eggs, the yolk occupied nearly the whole space.

In addition to the ovaries above described, there is a pair of organs in the abdomen, connected with the system of generation. They are straight, flat-cylindrical organs, usually as broad as the external oviduct, and lie along the central portions of the abdomen. At the lower extremity, they are connected with the oviduct a short distance above the vulva, and at the upper, they terminate in a cul-de-sac. They contain a single series of transparent, flattened globules, (fig. 18,) occupying, like beads, their central line, and in width about one half the width of the ovary. These false ovaries, when torn or cut, do not emit an albuminous fluid, like the true oviducts, but appear to have a gelatinous consistence. They are as much developed in the young, as in the old females.

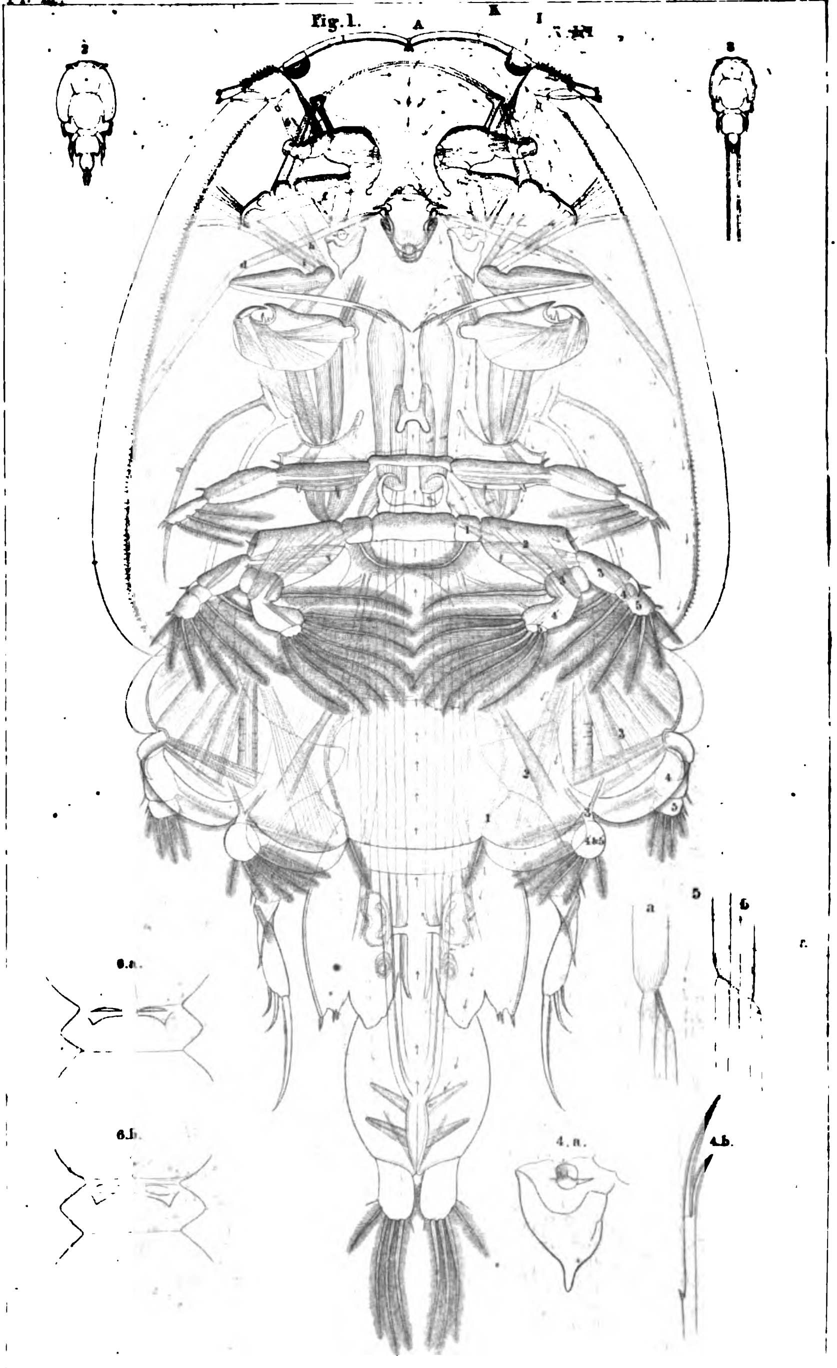
The eggs in females of the same size present very different degrees of development. We have seen full grown individuals with no eggs in the abdomen, and consequently, instead of the swollen appearance usual in the adult female, their abdomens could scarcely be distinguished from those of the male sex. Occasionally, very young individuals have had external ovaries; the smallest observed was scarcely one sixth of an inch long. May we not infer from this, that a single coition is sufficient to impregnate the individuals of at least *one* succeeding generation?

A few instances have come under our notice, of a very extraordinary irregularity in these organs. The extremity of the *false ovary* has been seen hanging externally in the place of the regular external ovaries, and no eggs, nor the internal oviduct, were discoverable in the interior on that side. Moreover, the corresponding ovary near the stomach was discovered with difficulty, and appeared like a folded empty sac. At the same time the ovary and the ovarian tube on the other side presented their usual appearance. This singular derangement was observed in a full grown female, which was perfect in all its other organs.

An additional peculiarity as yet inexplicable, has been observed in some females. The lappets at the extremity of the abdomen, each side of the tail, have been already described as very short in the female. On their lower surface there is an irregular osseous process, from which a slender corneous organ, which we suppose to be a duct, runs forward and a little inward, gradually diminishing, and terminates with a few irregular curves, (fig. 18, Pl. V.) The peculiarity we refer to, is an appendage to this lappet, arising from the termination of the internal duct, (fig. 22.) It is a long corneous duct, wholly external, terminating in an oval sac of similar texture, and usually filled with a whitish fluid. These appendages have been observed in a few instances, hanging each side of the terminal joint of the body, (fig. 22.) In one instance the ducts were crossed over the adjacent articulation, and each attached by its sac to the lappet of the opposite extremity. These are the only facts that have been discovered respecting these singular organs. They were found attached to very few individuals, and in these the eggs were scarcely developed.

On account of the many similarities between this animal and the Argulus, it may be interesting to trace a few of its analogies.

The number of legs or organs for locomotion is the same, being eight in each. Of the four pairs of natatories in the Argulus, two are similar in their use in the Caligus, while a third is expanded into an apron, and a fourth is attached to a distinct joint, and has but little strength. The anterior pair of maxillipeds in the Argulus very much resemble in general form the same organs in the female Caligus. The fourth pair is large and prehensile in each, though very different in form. There is a distinct suture in the former, near the anterior margin of the animal, which corresponds to the articulation between the two cephalic segments in the latter; but this segment, which in the Caligus is furnished with antennæ, is wholly without even rudiments of these organs; we may hence infer that the Argulus is destitute of antennæ, as is



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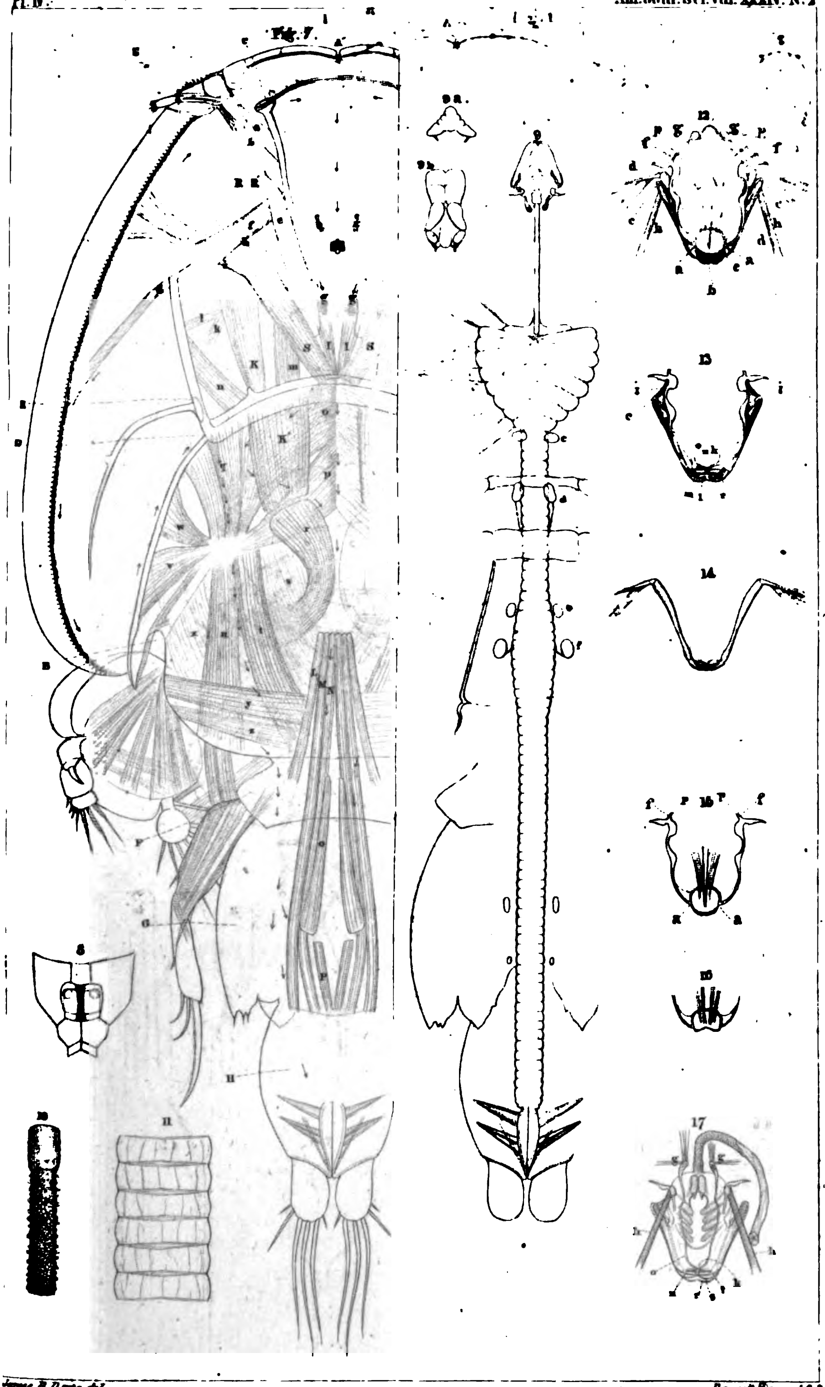
CALIGUS AMERICANUS



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Pl. V.

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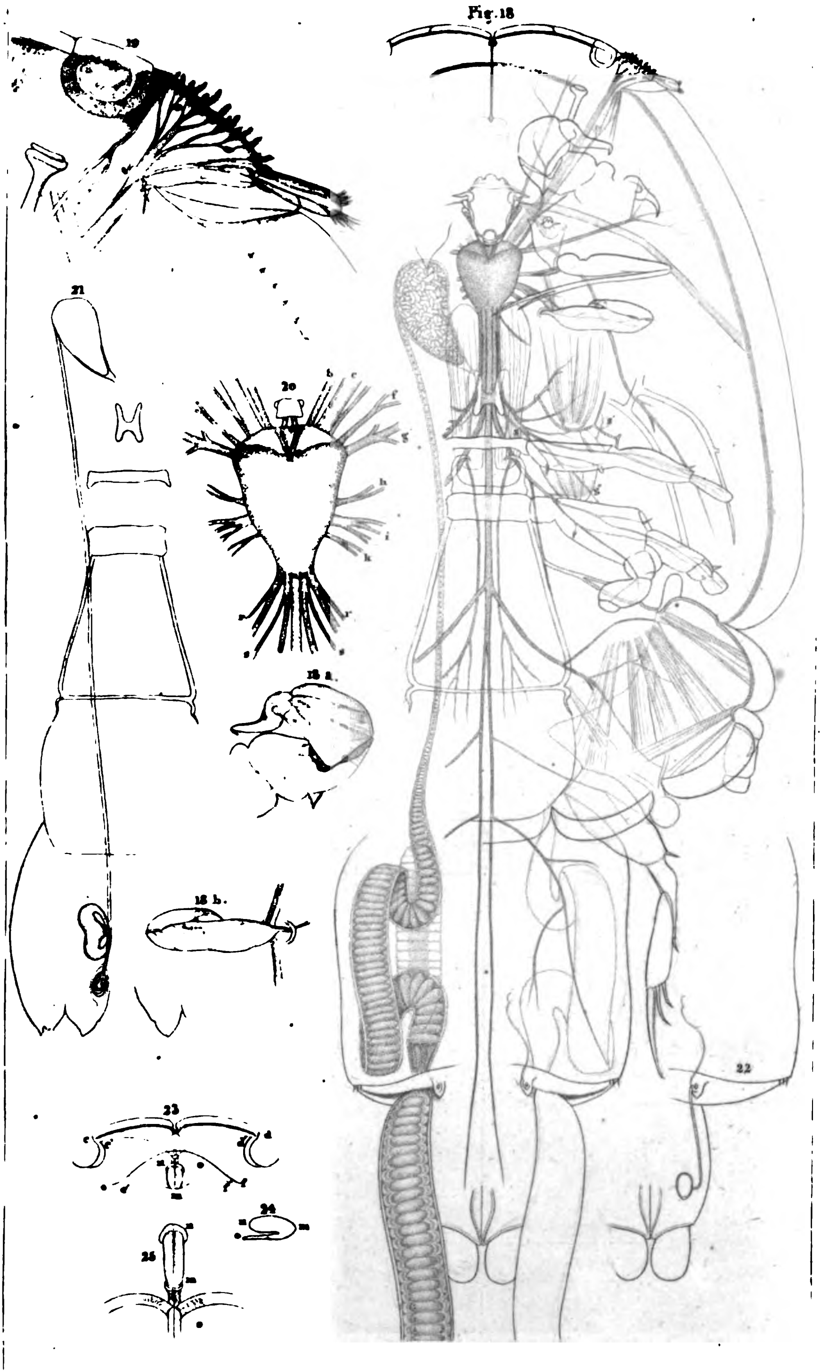

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CALIGUS AMERICANUS

also evident from the nature of the organs that follow. The space contained within the U suture in the Argulus is the analogue of the much larger and more distinctly separated segment, which we have called the cephalic in the above description. The anterior abdominal joint of the Caligus is wholly wanting in the Argulus; and the valves in the circulation which occupy the posterior thoracic joint, *far* from the extremity of the body, have an analogous situation in the Argulus, *close* to the *last* joint of the body. This joint being small in the Argulus forms a very distinct and regular heart, and serves to keep up a much more active circulation than in the Caligus, where the corresponding part is large and less energetic in its action. It is remarkable that the circulation in the two should be the reverse in almost every particular; the ventral current instead of being upward in the Argulus runs towards the terminal joint of the body; instead of meeting from the two sides in front and returning down the medial line, it goes out in two currents near the medial line and returns in the wings of the shell. This however will not appear so extraordinary when we consider that the animals are the reverse of one another in some particulars. The cephalic segment in the Caligus is very large and broad, and there is therefore space for the current furnished to the antennæ and cephalic organs, to flow along the sides, and return along its centre; but in the Argulus, this portion is so small that there is only room for the out-current, and the blood is compelled to turn outward into the wings of the shell or thoracic portion, which is very much larger than in the Caligus. The currents are much more definite in their limits in the Argulus, and more uniform in their velocity and course; the particles of the blood are also less variable in size and form, being about $\frac{1}{2500}$ of an inch, in length. The organs of the mouth are also similar in position and in the form of the mandibles. This analogy might be traced much farther; but we reserve further remarks for a future occasion.

## EXPLANATION OF THE PLATES.

### Plate III.

Fig. 1. Under view of a male, exhibiting the various organs, and the muscles that move them. A, minute papillæ, supposed to correspond to inner antennæ; I, a cup, for the attachment of the animal; L, antennæ; d, one of the muscles moving the mandibles. The arrows point out the course of the blood.

Fig. 2. Back view of male, natural size of one of the largest individuals.

Fig. 3. A female, natural size.

Fig. 4. a. View of the rudimentary or second pair of legs, or maxillipeds; b, termination of third pair.

Fig. 5. a. Ventral muscle, exhibiting its subdivision between the sternums of the two pairs of natatory legs; b, a second subdivision in the same muscle, below the posterior of the above sternums.

Fig. 6. a and b. View of the posterior thoracic joint, (see fig. 7,) with the valves in the circulation; the two lateral valves on the back and the central on the venter.

## PLATE IV.

Fig. 7. Back view of a male, with the muscles seen in this view. Those marked with capital letters, move the segments of the body; those with small letters, move the several organs below. F, the posterior thoracic segment; G, the anterior abdominal; H, the posterior abdominal.

Fig. 8. A portion of the shell about the eyes, shewing the areolets exhibited by it; the dotted line marks the limits of the dark ground on which the eyes are situated, and the dotted circles the eyes themselves.

Fig. 9. Alimentary canal, exhibiting the esophagus, the stomach and the intestine, with its glands, and the muscles of the rectum. The mouth at the upper extremity is represented as turned back, so as to show its under surface.

Fig. 10. Anterior extremity of the esophagus.

Fig. 11. A portion of the intestine.

Fig. 12. View of the *buccal mass*, in its natural position. Between the line a a, and a b a, is the opening to the mouth. d, the outer extremity of the mandibles, with the tendon and its muscles attached.

Fig. 13. The same with a portion of the upper membrane and the mandibles removed.

Fig. 14. The mandibles, together with some of the organs adjacent to their inner extremities, showing their relative position.

Fig. 15. The upper lips, with its two pairs of muscles.

Fig. 16. The same, with the extremity retracted by the inner pair of muscles.

Fig. 17. Under view of the buccal mass, with the esophagus attached. h h are processes lying in the teguments of the body, with which the buccal mass forms an articulation at their anterior extremity. g the processes in which the elevators of the buccal mass are inserted.

## PLATE V.

Fig. 18. Under view of *female*, exhibiting the nervous system, and the ovaries, and ovarian tubes. Fig. 18, a, the first pair of maxillipeds in the female; 18, b, the fourth pair in the same.

Fig. 19. A view of the cup and an antenna, together with a portion of the lateral margin of the animal, exhibiting its spines. The dotted lines in the antenna represent the nerve with which this organ is largely supplied.

Fig. 20. The cephalic and thoracic ganglions, exhibiting their close union, and the nerves they give out; the outlined organ in front, represents the eyes, attached to the ophthalmic nerves.

Fig. 21. Genital system in the male.

Fig. 22. Part of the abdomen of a female with an appendage to the same.

Figs. 23, 24, 25. Illustrate some facts connected with the change of skin.

## Art. II.—*On the Aurora Borealis of November* 14, 1837; by Frederick A. P. Barnard, A. M., Prof. of Mathematics and Natural Philosophy in the University of Alabama, Tuscaloosa.

The splendid display of auroral glories which took place on the 14th of November, 1837, was undoubtedly one of the most extensive and most beautiful on record. It accordingly attracted the attention of a great number of observers, of whom many, in this country, have communicated to Mr. E. C. Herrick, of New Haven, and to Professor Olmsted, of Yale College, the particulars of their observations. It was the intention of Professor Olmsted to offer, in the April number of the Journal, an abstract of these communications, but the pressure of other engagements has compelled him to commit to another, the task of preparing such an abstract.

Observations on the Aurora, to be valuable as the means of detecting the laws which regulate this phenomenon, and of affording data, from which to determine or to conjecture its causes, should, of course, be extended through a long period of time, and embrace a vast number of particular facts. They should be conducted by many observers, in different places, simultaneously and with concert. They should, moreover, be regulated according to a system, previously understood by all who take part in the observation.

It follows, therefore, that from the collected accounts of a single display of this brilliant meteor, especially if these are expressed in language generally too vague, in regard to directions and times, to allow of an identification of its particular phases as observed from different points of view, little can be inferred as to the nature of the phenomenon itself, or the altitude of the luminous cloud above the surface of the earth. Such records may, nevertheless, in the progress of science, be discovered to possess a value, which we are unable at present properly to appreciate.

The city of New Haven had been visited, during the day of the 14th of November, with a moderate storm of snow, which began to subside between the hours of five and six in the evening. The heavens continued, however, to be more or less obscured by clouds during the entire evening; on which account the splendors of the aurora, as they manifested themselves to observers more favorably situated, were here in a great degree concealed. The veil of snow clouds, which, at sunset, and for some time afterward, covered the sky, was nevertheless exceedingly thin; and it was through this, and even through the falling snow itself, that the first visible indications of the presence of an aurora were discovered. It is impossible to state the exact time at which the action commenced. There is no doubt that it had been going on for a while, before the intensity of the light became sufficient to penetrate the screen. The first evidence of its existence consisted in a strong rosy illumination of the entire arch of the heavens. In a communication prepared by Professor Olmsted, at the time, for the New Haven Herald, this appearance is described as follows:—

"The snow of yesterday, which at sunset had covered the earth and all things near it, with a mantle of the purest white, closed, early in the evening, with a most curious and beautiful pageant. About six o'clock, while the sky was yet thick with falling snow, all things suddenly appeared as if dyed in blood. The entire atmosphere, the surface of the earth, the trees, the tops of the houses, and, in short, the whole face of nature, were tinged with the same scarlet hue. The alarm of fire was given, and our vigilant firemen were seen parading the streets in their ghostly uniform, which, assuming the general tint, seemed in excellent keeping with the phenomenon.

"The light was most intense in the northwest and northeast. At short intervals it alternately increased and diminished in brightness, until, at half past six, only a slight tinge of red remained on the sky. It is presumed that places favored with a clear sky, enjoyed a splendid exhibition of the Aurora Borealis, the light of which was transmitted to us through the snowy medium and a thin veil of clouds, and was thus diffused like the light of an astral lamp, covered with a red shade of ground glass. That the stratum of clouds was very thin, was inferred from the fact, that before half past six, a few stars were discernible as when seen through a fog; and such was the appearance of the moon which rose about the same time."

The memoranda of Mr. E. C. Herrick, recorded at the time, correspond very nearly with the account given by Prof. Olmsted. Mr. Herrick says: "The sky was overcast and snow was falling in small quantities, when about twelve minutes before six (mean time) the heavens began to assume a fiery appearance. Within ten minutes, the whole clouded hemisphere shone with a brilliant red light. The snow on the ground reflected a fine rosy tint, and greatly enhanced the glory of the scene. The auroral flush overspread all parts of the sky almost instantaneously; yet there is some reason to believe that it started mainly from a spot near the W. N. W. as did the great aurora of Jan. 25, 1837. In a few minutes the light began to fade, and within a half hour, the exhibition ended. During the whole display, the clouds prevented our seeing even a single streamer.

"After the first fit was over, and during the remainder of the evening, the view of the heavens was much obscured by clouds. There was undoubtedly a return, partially observable here between nine and ten; but it seems to have been inferior to the previous display."

Had there been no farther visible indications of auroral action, however, Mr. Herrick would still have inferred the existence of a very powerful aurora, from the violent agitation of the magnetic needle during the evening. His observations on this instrument were continued for several hours. They were made with the assistance of Mr. A. B. Haile, of Yale College. The experience and accuracy of both these gentlemen in observations of this nature, are well known. Mr. Herrick remarks: "The needle was more disturbed between 6 and 10 P. M., than I ever before knew it to be during an aurora. It often moved thirty minutes in three seconds of time. Its entire range was nearly *six degrees!* At 6h. 26m. it stood at 3° 10′ west, and at 9h. 10m. at 9° 7′ west. Its mean position in its present situation and at the present time, is 5° 50′ west."

The number of magnetic observations made by Messrs. Herrick and Haile during the evening, amounted to seventy six. An interval of nearly an hour and a half occurred, from 7h. 45m. till 9h. 9m., during which no observations were made. All visible indications of an aurora had at that time disappeared; and the oscillations of the needle had become so much less remarkable, that it was not considered important any longer to watch them. It was, therefore, with no little surprise, that the observers, on returning to their post at a few minutes past nine, found the variation to be nearly two and half degrees greater than the mean. The following is the entire table of their observations.

### *Observations on the magnetic needle at New Haven, (Conn.) during the great Aurora Borealis of Tuesday, Nov.* 14, 1837; by E. C. HERRICK and A. B. HAILE.

| Mean time. | Needle west. | Mean time. | Needle west. | Mean time. | Needle west. | Mean time. | Needle west. |
|---|---|---|---|---|---|---|---|
| h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ |
| 5 49 | 4 57 | 6 19⅚ | 6 | 7 2 | 5 45 | 9 15½ | 5 22 |
| 51 | 6 | 22 | 4 0 | 4 | 5 50 | ‡16 | |
| 53 | 5 25 | 23 | 3 48 | 9 | 5 50 | 17 | 6 30 |
| 55½ | 6 50 | Min. 26 | 3 10 | 12 | 6 | 18½ | 7 |
| *55¾ | 5 30 | 28½ | 4 | 13¾ | 6 5 | 22 | 7 7 |
| 57 | 5 35 | 30 | 4 40 | 15 | 6 10 | 30½ | 6 0 |
| 6 0 | 5 30 | 32 | 4 45 | 17 | 6 | 36 | 5 52 |
| 2¾ | 4 30 | 35 | 4 45 | 21 | 6 5 | 47 | 5 45 |
| 3 | 5 | 39 | 5 | 23¾ | 5 55 | 52 | 5 58 |
| 4 | 5 45 | 40 | 5 15 | 34½ | 5 50 | 56½ | 5 10 |
| 4½ | 6 | 40½ | 5 | 41 | 5 15 | 10 1 | 5 32 |
| †6 | | 43½ | 4 35 | 45 | 5 15 | 4 | 5 45 |
| 7 | 5 7 | 47 | 4 30 | * * | * * | 17 | 5 30 |
| 7½ | 4 45 | 49 | 4 25 | 9 9 | 8 15 | 22 | 5 30 |
| 10½ | 4 15 | 50¼ | 4 30 | 9½ | 8 30 | 38 | 5 22 |
| 11 | 3 55 | 52 | 4 45 | Max. 10 | 9 7 | 47 | 5 37 |
| 11½ | 4 3 | 54 | 5 | 11 | 8 30 | 11 0 | 5 45 |
| 12 | 4 15 | 55⅓ | 5 15 | 12½ | 7 15 | Ceased to observe. | |
| 15½ | 4 45 | 56 | 5 30 | 13 | 6 45 | | |
| 19 | 5 10 | 7 0 | 5 40 | 14½ | 5 45 | 76 observations. | |

[The instrument employed was the variation compass, described by Professor Loomis, at p. 221, vol. xxx. of this Journal. It is not strictly on the meridian; but the usual position of the needle at this period, at its station in the room, at this hour of night, is about 5° 50′ west. The next morning (15th) from 7 to 9, the needle was at its usual place.]

The foregoing table will be examined with interest. It corresponds with the results of numerous observations made by the same gentlemen on other occasions, in shewing that the influence of the Aurora Borealis upon the magnetic needle is not uniform in producing a deflection in the same direction. In the London Philosophical Transactions, for 1832, Mr. Faraday has demonstrated the fact of a necessary tendency of electricity from the equator of the earth towards the poles, in consequence of the diurnal rotation. Without an escape of the electric fluid from the northern latitudes, it is obvious that such a tendency, however great, would be a *tendency* only; without producing any actual flow of electrical currents. Mr. Faraday suggested, that such an escape might possibly take place occasionally, thereby producing the phenomena of the Aurora Borealis. Were this the case, there would exist below the needle a flow of electricity northward, and above it, southward. According to the laws of electro-magnetism it should seem, therefore, that the disturbance observed should, in every part of the northern hemisphere, take place invariably towards the east. During the great aurora of July 1, 1837, the general deflection, according to a statement inserted by Mr. Herrick in the New Haven Herald, was observed to be in that direction. The fact that it is not uniformly so, however, proves us to be still in ignorance of some, at least, of the causes by which it is produced. There yet exists a necessity for much careful observation. Observations too, on the variation of the intensity of terrestrial magnetism, and on the disturbance of the dipping needle, during the existence of auroral action, are much to be desired.

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* Splendor fading. † Going east rapidly. ‡ Going west rapidly.

### *Observations made in other places.*

The aurora of Nov. 14, was observed in the city of New York by the writer of this article, in company with Mr. John H. Pettingell of that city. The position of the observers was three and a half miles north of the City Hall, and one and a half beyond the limits of the city proper; being upon an eminence which commands an unobstructed view of the horizon in every direction.

At about a quarter before six, their attention was attracted by a very unusual appearance of the heavens. The sky was wholly overcast, as in New Haven, at the same hour; but the cloud was not sufficiently dense, absolutely to obscure all the stars; of which quite a number were observed from time to time, faintly glimmering through. A few light flakes of snow continued, also, still to fall. At the time of the first observation, the whole heaven was suffused with a lovely carnation, brightest, apparently, at the commencement in the zenith, but soon afterward rather toward the northeast. This tint, reflected on the snow, clothed all nature with a roseate flush, beautiful beyond description. It gradually faded; but at the end of an hour was still slightly perceptible.

The sky then rapidly cleared, and all traces of the aurora passed away. But at about half past seven, the north and east being still overcast, and some stratified clouds extending themselves along the horizon around toward the west, a brightness began to appear in the northwest, which, in a very short time, extended itself upward forty five degrees, in a column of diffused light, quite broad at the base, and tapering to a point. This column moved very slowly southward, and at length became divided into two of similar character. But in the mean time, in all the north, and especially in the northwest, numerous streamers began to make their appearance. They became faintly red at the height of about 30°, and the redness of the whole blended itself into one general cloud, while the columns continued distinct and white below. The changes were rapid, as is usual; but the red tint covered the heavens nearly to the zenith for a long time. No corona was formed. The moon, emerging from the clouds a little before eight, detracted from the brightness of the display, which was at no time very intense. The whole subsided, or nearly so, shortly after eight, and observations were discontinued.

But, at a few minutes before nine, the writer was summoned to witness a new exhibition of auroral magnificence, the glories of which no tongue can tell. The heavens were at this time wholly unclouded, with the exception of a single very small and faint cirrus high in the northwest. Innumerable bright arches shot up from the whole northern semicircle of the horizon, and from even farther south; all converging to the zenith with great rapidity. Their upper extremities were of the most brilliant scarlet, while below they were intensely white. At the formation of the corona, the appearance of the columns below, which were exceedingly numerous and brilliant, resembled what we may conceive would be that of bright cotton of long fibre, drawn out at full length. The comparison though humble, is more strikingly descriptive than any other the observer could invent. To attempt in language, a picture of the magnificence of the corona, would be utterly idle. It surpassed that of every other, that the writer has ever had an opportunity of observing. The intermingled hues afforded each other a mutual strong relief; and exhibited the most brilliant contrasts ever beheld. The stellar form was wonderfully perfect and regular. Toward the west, there was a sector of more than twenty degrees of unmingled scarlet, exceedingly magnificent.

The duration of this display was quite remarkable. For three quarters of an hour after its formation, which took place about nine o'clock, the corona continued, with variable brightness, to maintain its position a little to the south of the zenith. At about half past nine, the northern columns had become disconnected from it, and had subsided very low, the heavens being clear between. But long before this, and indeed, within a few minutes after nine, the south was as completely filled with corresponding columns as the north. For a time, therefore, we were over-arched by a perfect canopy of glory. The southern columns, which seemed to proceed downward from the corona, rested on an arch of diffused light, extending in a great circle from east to west, or nearly so, and being about twenty degrees, or a little more, above the horizon, in the centre. All below the arch was of the strange darkness so usual at such times in the north. The southern columns were at no time so bright as the northern, but they maintained their position, after these last had retired; extending still from the corona to the arch which formed their base. The appearance was at this time that of an Aurora *Australis;* and this continued for more than a quarter of an hour. Streamers, for a while, continued to shoot up irregularly in the north, but they did not again reach the zenith. By half past ten, the whole was over, and the charmed observers reluctantly abandoned the watch.

The numerous observations of Mr. Herrick, have demonstrated the probability, if not the certainty of a return, after midnight, of an Aurora occurring before. Although, therefore, three distinct and strongly marked *fits* of the phenomenon had already occurred on the evening of which we are speaking, the writer was curious to ascertain whether there was not another yet to come. Accordingly a watch was kept, and at about half past one, the north was observed to be illuminated with a strong diffused light, like the dawn, from which occasional streamers shot up faintly, so high as forty degrees. Before half past two these appearances gave place to a flickering light, which ascended in broad waves half way to the zenith. At a quarter before three, this began to subside, and observations were discontinued.

The presence of the moon detracted, undoubtedly, very much from the splendor of these successive exhibitions of celestial magnificence. But for this circumstance, it is believed that the display at nine o'clock would have been gorgeous, beyond any yet recorded by observers in this latitude. Indeed, the writer is disposed to believe that it was such, notwithstanding this disadvantage. None, at any rate, of the magnificent exhibitions of this nature, by which the past few years have been distinguished, have produced upon his mind an impression of so unmingled admiration and delight.

It is a fact not a little remarkable, and one which may serve to show how little the negative testimony of persons, not systematically observers, can be depended on, in regard to the occurrence even of the most magnificent and striking celestial phenomena, that of all the daily papers in the city of New York, amounting to nearly or quite twenty, the Commercial Advertiser alone, contained a notice of the later and more splendid appearances of this Aurora, while almost every one explicitly stated the fact of the flush which overspread the face of nature early in the evening. We quote a few sentences from the Commercial:— "The glories of the Aurora have been so often displayed to us of late, that we scarcely think of mentioning each nightly exhibition; but that of last night was so eminently lovely, that we cannot let it pass unnoticed. * * * *

"Our news collector, Capt. Siscoe, who resides at Staten Island, says that he never beheld so magnificent a spectacle. During the continuance of the auroral light, he could see as distinctly outside of Sandy Hook, as at mid-day—a circumstance he never knew before, and he believes that the oldest men on the island are of the same opinion. The illumination was so great, he says, that, at one time, the city of New York appeared to be within a mile or two of Staten Island."

The display at nine o'clock was observed in the town of Fonda, Montgomery Co., N. Y.. by Mr. Oran W. Morris of New York City. His account of its general appearance accords very well with that which has just been given. At one time, however, Mr. Morris observed two arches of diffused light in the south, below that on which the columns rested. Mr. Morris noticed particularly a bright red sector, similar to that already mentioned, on the west side of the corona. His position was at least one hundred and sixty miles, a little west of north, from that of the writer.

By a letter addressed to Mr. Herrick by Mr. Azariah Smith, Jr., from Geneva, N. Y., it appears that the first approach of the Aurora was at that place, unobscured by clouds. The following is an extract:—

"At 5h. 45m. a purple bow or streamer appeared in the W. N. W., at first, rising but about 10°. At about the same time another rose in the N. N. E. Both gradually increased in height until they reached the zenith, and at 5h. 55m., a complete corona was formed. The eastern beam, soon after its appearance, extended in breadth at its base, assuming a triangular form of a purple or carnation hue, with a golden colored streamer passing up through its centre. Streamers were general at this time in the north; but directly north, as well as nearly over head, the heavens were of a light greenish tinge. Soon after this, a purple cloud in the E. was peculiarly brilliant, and at 5h. 57m. a bright white streamer passed the north star, on its way to the west. At 5h. 59m. the whole appearance began to decline in brilliancy, especially the radiating point, and, at this time scarcely any light was observable 20° E. of N. * * * At 6h. 7m. bright carnation clouds appeared each side of the radiating point, which continued nearly fixed for three or four minutes, and gradually faded away—the radiating point having now nearly disappeared." Time in Geneva is about 16½m. earlier than in New Haven.

Mr. Smith gives very minute observations on the phases of the Aurora, continued until 8h. 8m., when clouds for the most part, obstructed the view of the heavens, and no auroral phenomena were visible. Faint appearances of the Aurora, seem, from his notes, to have continued until nearly half past seven; when they subsided only to re-appear almost immediately. A faint corona was formed at 7h. 35m.

Mr. Smith seems, also, for about five minutes, to have had a glimpse of our splendid exhibition at a later hour, though not sufficient to inform him of its magnificence.

From a communication inserted in the Daily Commercial Advertiser, of Buffalo, by Mr. R. W. Haskins, it appears that the Aurora was observable also at that place, at its first approach. Mr. Haskins states that, at 5h. 15m., the heavens being clear in the north, and for 50° both east and west of that point, an unusual ruddy appearance was noticed, not in this region, but still farther toward the east and west. Mr. Haskins continues as follows: "This soon faded, leaving barely a perceptible tinge; and instantly, when nearly all color had disappeared elsewhere, a space of some 15° in diameter, immediately west of Cassiopeia and Andromeda, and north of Pegasus, was lighted up with red of a deeper hue than any we had yet seen. This was entirely disconnected, on every side, from any auroral light or appearance whatever; and, from its centre, pencils of white radiated to the periphery on every side.

"This continued some five minutes, when, the white lines disappearing, the whole space in question assumed an uniform red color, which was almost instantly thereafter extended, in an arch of the same width, through our zenith, and down to the horizon about 60° W. of N. On the east, this light did not extend itself. During all this time, the clear space in the north which has been mentioned, retained its usual color and appearance."

Deep red streams, pencilled with white, then began to appear and fade in the north, but without the tremulous motion of *merry dancers.* Those in the N. E. maintained their brightness longest, and moved slowly toward the eastern point of the horizon, near which they disappeared at a given vertical line. The usual haziness in the north began first to appear at 5h. 43m. Difference of time between Buffalo and New Haven, 23m. 48s.

Mr. Haskins proceeds: "At 5h. 47m. the clouds had become more dense and dark, (though still in detached masses,) particularly throughout that portion of the heavens which had been occupied by the red arch above mentioned, and these isolated clouds now assumed an appearance at once novel and striking. Those west of our zenith, and lying within the track of the crimson arch already described, suddenly exhibited the most vivid red along their entire *southern borders;* while the like clouds east of our zenith, and following the same track, and prolonging it quite down to the eastern horizon, assumed the same vivid color upon their *northern borders;* while no other portion of these clouds exhibited the least appearance of auroral light, in any of their parts. South of this line, there was at no time any auroral light whatever; and at the moment in question, there was very little in any other parts of the heavens, save on the borders of these clouds. At 5h. 51m. the red edgings of these clouds began to fade, and immediately a wide space in the N. E. that was still free from clouds, was most brilliantly lighted up. The color was of the same deep red, but it did not extend down to the horizon; and this had scarcely endured four minutes, when the whole region N. of our zenith, to within about 8° of the horizon, was again reddened and glowing: while, beyond these limits, either

N. or S., no vestige of the Aurora was visible. At 5h. 58m. the moon appeared above the horizon, and as it was only two days past the full, its beams soon surpassed in brightness those of the Aurora, and farther observation of these last became impossible."

It is to be regretted that Mr. Haskins did not repeat his observations at a later hour, as it is hardly to be doubted that the subsequent displays observed at Geneva, and at Hudson, as well as elsewhere, would have been at least partially visible to him. Mr. Haskins says, that he was unable to detect any disturbance of the magnetic needle. The instrument used, was a common surveyor's compass; which was, moreover, compared with another, both being considered good instruments. The apparatus was, undoubtedly, not sufficiently delicate; but it is a fact which has led to much discussion, that the needle is often greatly disturbed in one place by an Aurora, when in another, it is scarcely affected at all. Thus it is stated in the second Report of the British Association, for 1832, that during the great Aurora of the 7th Jan., 1831, M. Arago observed the magnetic needle to be powerfully affected, while Mr. Sturgeon of Woolwich, could not observe it at all.

At the Western Reserve College, Hudson, Ohio, some of the earlier displays of the phenomenon were noticed by Professor Elias Loomis, but the exhibition at nine o'clock, and after, (in New York,) was concealed by clouds. Professor Loomis says: "This evening at about five minutes after six, I observed the commencement of an Aurora. A small pile of light, of a reddish hue, lay upon the horizon, in a direction a little north of N. W., and a similar pile in the E. N. E. Between these there was a low faint cloud, bounded by a somewhat ill defined arch, rising in its centre about ten degrees from the horizon. Above this arch, a diffused light streamed upward toward the zenith, in one or two places, being somewhat more condensed, forming beams. This light increased rapidly in brightness, it became of a more decided crimson color, extended up to the zenith, and at the same time, light began to shoot up from several points in the east, and somewhat south of east. At a quarter past six, mean time, a pretty regular arch was formed, extending from the above-mentioned pile of light in the N. W., a little north of *alpha Lyrae*, south of *alpha Cygni*, about half way between Markab and Scheat, and about 15° S. of *alpha Arietis*. This arch was rather irregular in its outline, and had a slightly crimson color. In about five minutes another arch of white light partially formed in the southern sky, rising about 10° above Fomalhaut, and having nearly the same direction with the preceding. This arch was never complete, and soon vanished entirely. The great arch I have before described, brightened up again, in very nearly the same position as before, being perhaps a little more regular in its outline. * * * * About half past eight, light of a crimson color was observed to shoot from the eastern horizon toward and beyond the zenith, nearly in the position of the former arch. The heavens were now nearly covered with thin cirro-cumulus clouds, and the contrast of the ordinary clouds with this crimson auroral light, produced a very singular effect. The sky remained cloudy during the night, and the next morning there fell a few flakes of snow."

The time at Hudson, is about thirty-four minutes earlier than at New Haven. From the accounts given by Mr. Smith, Mr. Haskins, and Professor Loomis, it seems impossible to identify any particular phases as having been noticed by any two of the observers. Professor Loomis was probably mistaken in supposing that he saw the commencement of the Aurora. At the time of his first observation, a corona had already formed itself, and faded away at Geneva. The accounts just given, hardly satisfy us in regard to the splendor of the first auroral display. We are forced to believe that, but for the clouds, it would have been much more magnificent in the cities of New Haven and New York, than it is here represented to have been.

The Aurora, (to go still farther west,) was observed in the city of St. Louis, Mo. The Republican of that city remarks: "This beautiful and interesting phenomenon, was visible during nearly the whole night, and was particularly brilliant between the hours of twelve and one, when the moon was near its zenith." Time in St. Louis being rather more than an hour earlier than in New York, this last display was contemporaneous with the latest return of the Aurora in our longitude: but this, which was the least energetic here, appears there to have been the most remarkable.

From places north of New Haven, we should, of course, anticipate accounts of the appearance of this phenomenon. A letter from Professor A. W. Smith, of the Wesleyan University at Middletown, Conn., to Mr. Herrick, describes the heavens as they appeared, from half past five till half past six, in terms very nearly corresponding to those used by Professor Olmsted, and already quoted. Professor Smith adds: "About nine o'clock there was a corona formed a little south of the zenith, highly colored, as on the 17th November, 1835. Streams of auroral light were also faintly visible at the same time in the north." It is very obvious that the magnificence of the exhibition at nine was by no means so great in Middletown as in New York.

Professor O. P. Hubbard, of Dartmouth College, Hanover, N. H., in a letter to Professor Silliman, also mentions the appearance of the Aurora at that place; but without giving a particular description.

East of New-Haven, the snow storm seems to have been more protracted than in this city. The rosy flush observed here at six o'clock, was nevertheless seen in New London, in this state, though the snow was falling copiously at the time. A letter to Professor Olmsted, from Mr. J. Hurlbut, of the latter place, dated Nov. 14, says: "The snow has fallen incessantly since five o'clock this morning, and up to this hour (eight o'clock, P. M.) the storm has not in the least abated. But, at about six o'clock, it seemed as if the heavens were on fire. A lurid light on all sides, from the zenith to the horizon, cast a most vulcanean hue on the fallen snow. This lasted about half an hour, and then disappeared. The light seemed the same in every portion of the heavens, but without any apparent cause."

South of us, the distance to which this beautiful exhibition was visible, at one time or another, during the course of the evening, was very unusual. From a large number of notices we select a few of the more circumstantial, and present them in the geographical order of the places from which they come, proceeding southward. The United States Gazette, published at Philadelphia, after noticing the early appearance of the heavens, which was not dissimilar to that observed at New York, continues: "At a later period, the lights were again visible, and between nine and ten o'clock, exceeded in extent and brilliancy, any thing of the kind ever before witnessed in this latitude. A broad field of crimson flame, stretching from nearly a western course, and reaching the eastern hemisphere, encompassed the heavens with a brilliant glory, of indescribable beauty and magnificence, hanging, as it were, suspended from the blue vault above, like an immense curtain over the earth—while, from almost every point of the compass, shot up rays of rich and gorgeous light, spreading and intermingling with a wavy tremulous motion, and exhibiting every hue which the rain-bow can boast. The richness, variety, and delicacy of the colors, were surprisingly beautiful, as was their prismatic brilliancy.

"The sky itself was remarkably clear and cloudless—and through the celestial phenomena, a full moon and innumerable stars were, all the while, distinctly visible. We never had the satisfaction of witnessing a display so truly grand and magnificent, and only regret our inability of conveying even a faint idea of the sublime wonder, and beauty of the scene."

Other persons seem to have observed a greater variety of *colors* than were visible to us. Red, orange and golden yellow, with sometimes a shade of pale green, doubtless an optical illusion, as being the color complementary to the first, were all that were remarked in New York.

Professor L. Obermeyer, of Mt. St. Mary's College, Emmittsburg, Md., writes to Professor Olmsted, under date, Nov. 18, as follows: "On the evening of the 14th inst., a brilliant display of an Aurora Borealis was witnessed. The first indication of its approach was given as soon as it became dark, by the singular redness of the cumulo-stratus clouds, now entirely covering the sky. Those in the north, south, east and west, all partook of the redness; and the reflection from them was strong enough to give a red tinge to the snow, still several inches deep. The heaviest clouds retained their dark color in the centre, but they were bordered with red. During the hour in which this state of things existed, there were no streamers, streaks of light, nor merry dancers. Indeed, where the sky could be seen between the clouds, there were no signs of an Aurora, but rather a deep green sky. By seven, the moon being risen, and the clouds having vanished, nothing remained to show that there had been any unusual occurrence. A little after nine, however, the sky being perfectly clear, an Aurora suddenly sprung up, which, for magnificence has seldom been equalled in this latitude. The streamers from the east, west and north, converged a few degrees south of the zenith, forming a beautiful auroral crown, red as scarlet, but intermingled with streaks of pale light. There were no *merry dancers.* All the other appearances usually witnessed on such occasions were noticed. In little more than half an hour, the grand display was over. A few traces were seen for a little time longer, when every vestige disappeared." The time at Emmittsburg is 18½m. earlier than at New Haven.

A letter from President Humphreys, of St. John's College, Annapolis, Md., to Professor Olmsted, speaks of the Aurora of Nov. 14, as "more magnificent than any that has ever before occurred" there. Mr. Humphreys proceeds: "It [the Aurora] extended many degrees farther south than the great one in January. It came on in waves, as before, at about a quarter before six, and returned at seven, at eight, and at nine. The first arch was formed suddenly, and became vertical in a very few minutes, from the first appearance of the columns at the N. W. and S. E. It was crimson, traversed by white pencils. The magnetic variation was diminished 1° 5′. It is here, west." A communication also appears in the Republican, of Nov. 18, published at Annapolis, proceeding, likewise, probably from President Humphreys, and giving a more particular account of the returns at eight and nine. It is remarked that, "the color of the light at 8h. was not red, but dusky, and formed from the N. W. point to the pole star, a broad column, which kept its position for half an hour. A succession of fine cirrous clouds floated off from the lower parts of the column to the south. At 9h. the recurrence of the crimson light was more in patches, and of intense brightness, accompanied by cirro-cumulous clouds, which were formed suddenly over the whole sky, and were borne swiftly to the east by the wind, and at apparently a greater elevation in the atmosphere than that of the Aurora."

The latter opinion of President Humphreys, in regard to the comparative altitude of the auroral and the ordinary clouds, is undoubtedly a mistaken one. But for the presence of these latter, he would unquestionably have observed something more than patches of crimson light, since the corona was seen by persons in almost every direction from Annapolis. Difference of time between New Haven and Annapolis, 15m.

From Fairfax Co., Va., near Alexandria, Professor R. Tolefree writes, of the early display: "From E. S. E. to W. S. W., was exhibited a rich orange red color, extending even to the zenith, and covering all the heavens north of these points." Professor Tolefree observed the return, in a brilliant and fiery form, toward nine o'clock; but he observes that, "by a quarter past nine, the

Aurora was no longer visible." It is probable that the clouds of which he previously speaks, obstructed the view. The time at Alexandria is about 16½ minutes earlier than at New Haven.

At Richmond, Va., the magnificent corona formed between eight and nine o'clock, was observed by many persons, but from that place, no statements in detail have reached us.

We come now to two communications from points much farther south than any of the preceding, and situated in latitudes so low, that the occurrence of an Aurora Borealis is there a phenomenon of exceedingly rare occurrence. The first of these is a letter to Mr. Herrick, from Mr. W. A. Sparks of Society Hill, S. C., in latitude 34° 35′ N., nearly. Mr. Sparks observes: "My attention was directed towards the north early in the evening, (about six o'clock,) by an unusual luminous appearance, and after gazing intently for a while, I distinctly recognized what I had long and earnestly sought for without success, a "bank or storehouse" of auroral vapor. * * * When I first observed it, a space of about 15° above the horizon was strongly marked by a pale white light, above which the crimson hue peculiar to this phenomenon began to be distinctly visible. At this time, the greatest degree of brightness was to the east of north, assuming no very definite form, but extending, as well as I could judge, about eight or ten degrees east, and reaching in height to the constellation of Cassiopeia's chair, the lower portion of which was enveloped in its reddening glow." The action then subsided, but at about eight o'clock, another bright crimson column ascended due north, attaining an altitude some degrees greater than that of the polar star, and maintaining its place about half an hour. After this had faded away, no return was observed till about half past nine, when Mr. Sparks observes, "I again perceived another broad arch of crimson light, ascending several degrees to the west of north. The altitude of this latter column was greater than that of any of the preceding, but I regret to say that my ardent desires to see it 'scan the blue vault, and in the zenith glow,' were not fully realized." Time at Society Hill is about 27½m. earlier than at New Haven. At the moment of this last mentioned return observed by Mr. Sparks, the crisis of the action in our longitude was past.

The other communication just alluded to, is a letter addressed to Professor Silliman by Mr. J. Darby of Culloden, Geo., latitude about 32° 45′, N. Mr. Darby writes: "Immediately after dark, or at about six o'clock, the sky a little to the north of the star Capella, began to appear luminous, and a luminous arch was soon formed, of about 6° or 8° in breadth, and extending over to the north-western horizon, having the pole-star in its highest point. Soon after the arch was formed, that part of it in the N. E. horizon became much brighter, and somewhat broader than the rest; and this luminous portion gradually rose, and passed on in the arch; its densest part culminating a little below the north star. It continued its motion to the western horizon.

"The passage of the luminous part of the arch occupied an hour and a half. It became somewhat fainter, after it had passed the meridian. The arch gradually passed off, beginning first to disappear in the east, so that not a vestige remained at nine o'clock, three hours from its first appearance. * * * The color of the arch was that of light scarlet, and the most luminous part a little darker, and much more intense. It appeared to be a semicircle, having for its base about 60° of the horizon. It differed from the Aurora in its regular outline, and its regular motion from east to west. It was observed with wonder by many in this region, and was such as no one had ever witnessed before." Time at Culloden, 45m. earlier than at New Haven, nearly.

At the date of this letter, Mr. Darby was not aware of the contemporaneous occurrence of the Aurora at the north. The appearances he describes are certainly very unusual; but must, of course, be attributed to the phenomenon which was at the time exciting so great admiration and astonishment, throughout all the northern states.

We learn from some of the English journals, that this Aurora was seen in Great Britain. It is mentioned in a number of the Cambridge Chronicle, published in November, and also in Loudon's Magazine of Natural History, No. XII, Dec. 1837. Its splendors seem to have been in a great measure concealed by clouds, and the Aurora of Nov. 12, two days previous, attracted a much higher degree of attention. A notice of this latter phenomenon, by J. H. Stanway, Esq., of Brookfield, near Manchester, dated Nov. 15, and published in Loudon's Magazine, contains this incidental mention of the Aurora under consideration:

"My attention was also last night directed, by the oscillations of the needle, to the existence of an Aurora Borealis; but, by reason of the interference of clouds, it was not long visible. The variations noted, were as follows:—

| *h.* | *m.* | | *h.* | *m.* | |
|---|---|---|---|---|---|
| 11 | 15 | 28° 25′ | 12 | 30 | 28° 30′ |
| “ | 45 | 27 24 | “ | 45 | 25 26.” |

The mean variation for the month of November, had been determined to be 26° 48′ 45″. The writer continues:—

“At half past twelve, a patch of the most intense blood red colors which I have ever seen, was visible, free from the interposition of clouds. The whole of the sky had an awful appearance; for the tinge of red which pervaded *the whole expanse*, assumed, in many points, from the depth of colors above, and the density of the clouds below, the dark copper tint, which is seen on the disk of the moon during a lunar eclipse.”

The time here mentioned would correspond nearly to a quarter before eight in New Haven; and the display which seems to have been observed at its height, must have been almost contemporaneous with some of the earlier appearances noticed in this country. The time included between the earliest and latest observations on the needle, is equivalent to that from half past six to eight, here.

None of the scientific periodicals published on the continent of Europe, of a date sufficiently recent to contain notices of this Aurora, have yet reached us. Considering the intensity of the auroral action in England, as observed by Mr. Stanway, we cannot doubt that the phenomenon manifested itself over a great part, if not the whole, of the continent.

## *General Remarks.*

In considering the various accounts, not only of this, but of all great Auroras, we are not the least astonished at their vast extent. There can hardly be a doubt that often, at the same moment, the auroral action is going on in every longitude of our hemisphere; and possibly, at the same time, quite as extensively in the southern hemisphere also. True, there is commonly believed to be some mysterious connection between this phenomenon and the absence of the sun, or, in other words, the night; but to what can this be owing, save to the fact, that, during the day, the light of the Aurora, like that of the stars, is necessarily swallowed up in the overpowering radiance of the sun? On one occasion during the last autumn, the writer, being on Manhattan Island, a little north of New York city, was fully persuaded that a powerful auroral action was going on, between the hours of eleven and twelve, A. M. The sun was, in the mean time, shining, without the slightest cloud to obscure his lustre; but along the north there lay a heavy bank of haze, above which a flickering or wavy light was obvious to the eye for more than half an hour. The same appearance was also noticed by Mr. J. H. Pettingell, of New York, who continued to observe it after the writer's attention was withdrawn. No magnetic needle was at the time accessible; and accordingly it was impossible to verify the truth of the observation, by an appeal to that instrument.

In a paper appended to a Report of the Regents of the University of the State of New York, for 1836, it is stated by Professor Joslin, that, on the day following the great Aurora of Nov. 17, 1835, "there was such a display of auroral clouds as almost to justify us in considering it a proper *Aurora seen in the day-time.*" But if the Aurora be exclusively a nocturnal phenomenon, it is desirable that the fact should be established. This will be one step, at least, toward the development of its causes. By a series of observations, the truth can be ascertained, either positively or negatively; but the needle must, from the nature of the case, be the chief means of bringing it to light.

The agitation of the needle during the existence of an Aurora, unobserved at the time, in consequence of clouds, but subsequently ascertained by observations elsewhere made, has been repeatedly noticed. An extract of a letter from M. Humboldt to M. Arago, contained in the *Comptes Rendus* of the French Academy of Sciences, No. 1, Jan. 1837, cites a statement of M. Gauss, inserted in the *Journal Astronomique de Schumacher*, No. 276, that the disturbance of the needle at Göttingen, on the seventh of February, 1835, was greater than ever before known; and adds that, at the same time, a beautiful Aurora was observed by M. Feld, Professor of Natural Philosophy, at Braunsberg, in Eastern Prussia. It is stated also in the *Comptes Rendus* of April 17, 1837, that, on the sixth of the same month, an Aurora was observed by M. Morren, of the College Royal d'Angers; and that, at Paris, in the mean time, the sky was covered with clouds, but the needle violently disturbed.

It is stated by M. Wartmann, of Geneva, in the *Bibliothèque Universelle* for October, 1836, that "an illustrious philosopher, M. Arago, has often announced in advance, the early appearance of an Aurora Borealis; being apprised of its approach by the extraordinary oscillations of the magnetic needle, which is regularly observed every day at the Royal Observatory of Paris; and that the event has confirmed his prediction on the same day, though frequently the phenomenon has occurred at such a distance as not to be observable at Paris." It would hence appear, that auroral action *has been* detected during the day, by the aid of the needle: and it is quite probable that the light would also have been observed in the absence of the sun.

Although the Aurora undoubtedly manifests itself, on many occasions, contemporaneously in places situated in every direction from the pole, there is no reason to believe that its intensity is, in the same latitude, every where the same at any given moment; nor that its successive *fits* come on, or reach their height, in different longitudes precisely at the same time. There is great reason, however, for the contrary opinion; as is manifest, indeed, from the various accounts which we have condensed in the present article.

Nor does it seem that the disturbing influence of the Aurora upon the magnetic needle is similar in different longitudes. There are three observations, of the four recorded in the extract above cited from Loudon's Magazine, which we are able to compare with corresponding observations made in New Haven. After making ample allowance both ways, for possible errors in time, we are able nevertheless to say with positiveness, that, while the needle in New Haven was deflected to the east; in Brookfield, near Manchester, its disturbance was in the contrary direction; the ordinary variation in both places being westward.

Not only are the causes of the Aurora as yet a sealed book to us, but we have not been able to ascertain, otherwise than conjecturally, the altitude of the illuminated substance above the earth's surface. It is even a question whether this substance is within or beyond the limits of the atmosphere. The question is one which it is exceedingly difficult to settle. To identify positively, particular beams seen from different situations, is not so simple a matter as it may seem. The same beams observed from different points of view, may present very different phases; while their fleeting existence and their mutability while they do exist, the great numbers which, in every striking display, commonly spring up and fade incessantly, and finally, the restlessness with which they are momentarily changing their positions, till at length they vanish, are all circumstances precisely suited to confound all simultaneous observation, and to render it next to impossible to obtain a parallax. These remarks apply to columns seen laterally. If to both the observers, the Aurora is coronal or vertical, the difficulty becomes still greater. Since the corona seems, every where, to settle itself at a point in the heavens in the line of the dipping needle, it follows that every place, during a vertical Aurora, must have its own corona, which can be seen from no other position. Were it not so, the distance of the Aurora might be determined at once; since the corona, if its apparent form were real, would present a most striking object, visible at the same time to a multitude of observers; while the steadiness of its position would afford abundant time for accurate observation.

There is one mode, and, as it seems to the writer, only one, in which the question admits of being settled. It may, after all, lead only to an approximation to the true altitude of the Aurora; still it may unquestionably determine the limit, beyond which the luminous vapor cannot be. This is to institute a series of observations along the same meridian, in order to determine, as accurately as possible, the lowest latitude at which the auroral columns, on a given occasion, reach the zenith. Let an observer, then, situated at any given distance due south, observe the greatest altitude at any time attained by the columns directly north of him, and a parallax may be obtained, by means of which the problem may be solved. For instance, on the occasion we have been considering, a corona was formed at Richmond, Va., and perhaps even farther south. At Culloden, Geo., the greatest altitude observed during the evening, was about equal to that of the pole star. Were these two places on the same meridian, we should be able to say, from knowing their difference of latitude to be 4° 47′ 17″ very nearly, that the height of the Aurora could not be much greater than two hundred geographical miles.

At Society Hill, the greatest observed altitude appears to have been about 40°. A similar calculation founded on this observation, would reduce the extreme height of the Aurora at its summit, to about one hundred and sixty geographical miles. It must be observed, however, that we know not how far south of Richmond the Aurora was vertical. If it extended a single degree farther south, we should infer an altitude of but very little more than one hundred miles.

The result of a calculation similar to the foregoing, made in Europe upon the Aurora of Oct. 18, 1836, by M. Wartmann of Geneva, is stated in the *Comptes Rendus* of April 17, 1837, to give an altitude of two hundred leagues, or about six hundred miles.

Two observers may obtain a parallax of the summit of the highest column observed due north, or of the extreme altitude in that direction of the general mass of illuminated vapor, when the Aurora is vertical to neither. This will give the distance of the Aurora from either observer, and by consequence its perpendicular height at the point where it is vertical. The mode of calculation, it must, after all, be confessed, is far from being so accurate as could be desired.

Mr. Dalton, in his Meteorological Essays, estimates the altitude of the summits of the auroral columns, at about one hundred and fifty English miles. Mr. Dalton's observations were made upon an auroral arch, at right angles to the magnetic equator, and he assumes this arch, and all others similar, without proof, to have an altitude equal to that of the highest extremities of the ordinary columns. Mr. Dalton supposes the auroral columns to be cylindrical, to stand nearly parallel to each other, in the line of the dip, and to have a length about ten times as great as their diameter, and about equal to the height of their bases above the surface of the earth. Allowing the auroral columns to be all of equal dimensions, a concession, however, which we cannot possibly make, Mr. Dalton's conclusions are pretty well sustained by observation, and by mathematical demonstration.

Mairan supposes the mean altitude of the Aurora to be one hundred and seventy-five leagues, or about five hundred miles; while Euler places it more than one thousand miles above the surface of the earth. On the other hand, we have estimates which give it an elevation no greater than that of the ordinary upper clouds, or confine it within the limit of a few miles. Such is that of Mr. Farquharson, of Scotland, who supposes the ordinary elevation of the Aurora to be 2000 feet at the base, and 4000 or 5000 at the summit. Such also is that of Professor Joslin, who supposes an intimate connection to exist between clouds of certain forms, and auroral phenomena. But these seem to find little support in mathematical computation, founded on the observation of parallax.

During the expedition of Capt. Franklin to the polar regions, however, in 1820, contemporaneous observations were made on three Auroras, by Lieutenant Hood and Dr. Richardson, in latitude 64° 2′ 24″, from points eighteen leagues distant from each other; and from the parallactic angles obtained by them, an altitude was deduced of two or two and a quarter leagues—equal to six or seven English miles. It is possible that the height may diminish as we approach the poles.

According to the theory of M. Hansteen, the auroral cloud is an emanation from the earth, which rises directly upward, but becomes luminous only on escaping from the atmosphere, at a height of forty five or fifty miles.

But there have been differences of opinion in regard to the origin of the auroral vapor, as to whether it is terrestrial or celestial. That it partakes of the motion of the earth, in its diurnal revolution, is sufficiently evident. Whether this fact alone will demonstrate it to be a terrestrial emanation, may possibly be disputed; but it is certainly an argument in favor of that belief.

The Aurora has been represented to be attended with rustling or crackling noises. In our latitude we have no very good evidence of the occurrence of these: and, indeed, if the auroral vapor be, in truth situated as far above the earth as our computations as yet compel us to place it, we know not how such audible evidences of its action can reasonably be expected. The case would be somewhat different, if the sounds described were heavy peals or explosions, like the reverberations of thunder. These sounds are represented as being more remarkable, and of more frequent occurrence in the higher latitudes. This circumstance might result from the more violent action of the Aurora, as we approach the poles; but it may, also, be in part, a consequence of the greater proximity of the phenomenon to the earth's surface. M. Mairan, believing the auroral matter to ascend from the earth, and during a coronal Aurora, from the immediate region of the observer, supposes these sounds to be occasioned by its upward passage through the lower regions of the atmosphere.

Thus far, however, the reality of such sounds, in any latitude, is seriously questioned. The Aurora is a phenomenon well suited to terrify the ignorant, and thus predispose them to connect with it a thousand marvels, which have no existence: and it may even so far excite the imaginations of the better informed, as to incapacitate them fairly to judge of the fact; since for the most part, their impressions are previously formed.

The world is, after all, very much in the dark, in regard to all that relates to this wonderful phenomenon. It is perhaps somewhat doubtful, whether, in our day, this darkness is to be enlightened. We certainly live in a remarkable era, as it respects the frequency and the splendor of auroral exhibitions; and the philosophers of the present time will grievously neglect their duty, if they fail to take every possible advantage of the opportunities of observation, which they are so happy as to enjoy.

**New Haven, Conn., Feb. 22, 1838.**

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## ART. III.—*On the Variation and Dip of the Magnetic Needle in different parts of the United States;* by ELIAS LOOMIS, Professor of Mathematics and Natural Philosophy in Western Reserve College.

ABOUT three years ago, I formed the design of collecting as far as possible all the observations which had ever been made on the variation of the magnetic needle within the limits of the United States. I was of opinion that such a work would contribute something to the cause of science, and might also be of practical utility to public surveyors, who very generally in this country make use of the magnetic needle in their surveys. The Connecticut Academy of Arts and Sciences, gave me permission to write in their name to gentlemen in different parts of the country requesting information on the subject. A great number of letters were written, and to most of them, answers have been received. The amount of information they embodied was not so great as had been expected. I therefore hesitated about prosecuting my original plan, and this, together with an absence of more than a year from the country, is the reason that those observations have not sooner been made public. Although the article which is here presented is very imperfect, being deficient in the number, and frequently in the accuracy of the observations, still it is thought that its publication may prove useful at least in two respects if in no others. First, some do not seem to regard it as settled beyond dispute, that the magnetic needle has at present a retrograde movement compared with its motion the last century. I trust the observations I have here brought together, may be considered as finally settling this important question. And secondly, it is hoped that this article may remind men of science of the importance of observations of this kind, and of the need there is of multiplying them to a much greater extent than has been hitherto done. And it is hoped moreover that they will not be content with simply making their observations, but that they will see to their publication. Probably many individuals who have taken observations sufficient to determine the magnetic variation in their respective places, have deferred publishing them because they did not regard the observations as of sufficient consequence. But although it is of little importance to the theory of magnetism to be informed of the variation of the needle at one place alone, yet when like observations are collected from every part of the country, their united value is immense. It is hoped then, that whoever has accurate magnetic observations which have not been published, will see that they are recorded in this or some other public journal. Such a record may be made within the space of two or three lines, and if the practice were extensively followed, we should have the materials for laying down with considerable accuracy the lines of equal variation throughout the United States.

The substance of the letters which I have received, may be gathered from the following observations. Mr. John Johnson, Surveyor General for Vermont, thus writes from Burlington: "In the year 1817 I determined the latitude of the source of the St. Croix, 45° 55′ N., and longitude about 67° 55′ W. The variation of the magnetic needle was here 14° W. Proceeding due north to latitude 48° 1′ N. I found the variation 17° 45′ W. In 1818, near Timiscuata Lake, latitude 47° 38′, longitude about 69° W., the variation was 16° 31′. In 1818 at the Matwaska settlement, on the river St. John, latitude 47° 12′, longitude about 68° 10′, the variation was 16° 45′ W.

"At the University of Vermont, in Burlington, near where I reside, lat. 44° 28′, long. about 73° 14′, I found in 1818, the variation 7° 30′ W.; in 1822, 7° 42′ W.; 1830, 8° 10′; 1831, 8° 15′;

1832, 8° 25′; in 1834, 8° 50′ W. The town lines north of Onion river, Vermont, were run from 1784 to 1787 at N. 36° E. About twenty years after, the same lines were N. 35° E., and the last summer I tried and found the same lines N. 37° 50′ E."

Prof. Farrar, of Harvard University, Massachusetts, writes thus: "I endeavored in 1810 to ascertain the variation of the needle in this place as accurately as I could. I made it 7° 30′ W., at 10 o'clock, A. M. I have now (July, 1835) observed the needle with great care almost every day for the last two months. The mean of my ten o'clock observations gives 8° 51′ W."

Prof. Hitchcock of Amherst College, determined the variation of the needle at Deerfield, Mass., in 1811, to be 5° 28′ W.

Mr. George Gillet, Surveyor for the state of Connecticut, determined the variation of the needle at Hebron, Conn., to be in 1805, 4° 50′ W., and in 1835, 6° 10′ W.

Prof. R. M. Patterson of Virginia University, lat. 38° 2′ N., long. 78° 31′ W., states that the needle there, in 1835, had no sensible declination.

Mr. John Bethune, surveyor for the state of Georgia, gives the variation at Milledgeville, lat. 33° 7′ in 1805 at 5° 30′ E., and in 1835 at 4° 40′ E.

Prof. James Hamilton of Nashville University, Tennessee, states the variation at that place to have been 7° 7′ E. in 1835, and adds, "I have lost the record of observations made several times since the year 1827, and have forgotten what the variation has been heretofore. The city surveyor however assures me that in the year 1829 I gave him the variation 6° 50′ E., and that he has it on record."

Mr. James H. Weakly, surveyor for the state of Alabama, writes from Florence: "The variation of the needle is here 6° 28′ E. During the years 1817, 8, 9, it was about 6° 35′ E. About the year 1809, it was 8° 10′ E. at Mobile; at this time it is about 7° 12′ E. During the survey of the Creek Territory in 1832, which lies on the eastern border of the state, it was found in some places in the northern part of the survey 5° 25′ E., and in the southern part about 6° 30′ E."

In addition to the preceding, the Hon. Timothy Pitkin, of Connecticut, has kindly put into my hands a collection of documents containing many very valuable observations. In 1810, a representation on the subject of the variation of the magnetic needle was laid before congress, by Mr. Shaw of Maryland. This representation was referred to the consideration of a committee of the House of Representatives, of which Mr. Pitkin was chairman. The committee deemed the subject of sufficient importance to merit investigation, and accordingly directed circular letters to men of science in different parts of the country, requesting information on the present declination of the magnetic needle. The answers to these circulars embodied considerable information of which the following is a summary.

President Wheelock of Dartmouth College, New Hampshire, states that in 1765, the declination of the needle was at Hanover about 7° W.; at present (1810) 4° 15′ W.

James Whitlaw, a surveyor in Ryegate, Vermont, lat. 44° 10′ N. and long. 72° 10′ W., states the declination at that place in 1801 to have been nearly 7° W.

President Messer of Brown University, Rhode Island, states the variation there in 1769 at 6½° W.; but in 1790 it was, *if the variation compass made use of could be relied on*, only 3° 46′ W. [I have myself italicised the above clause to intimate my conviction that there must have been some error in this observation, or else that the compass did not in both instances occupy the same spot. It is not credible that the needle had changed 2¾° in twenty one years.—E. L.]

Mr. Asher Miller of Middletown, Conn., states the variation at Danbury for 1810, at 5° 41′ W.; at Lyme 4° 30′; Pomfret 5° 5′; Hebron 4° 50′; East Hartford 4° 46′.

President Smith of Princeton College, New Jersey, gives the variation at that place for 1810 at 7° W.

Andrew Ellicott, surveyor of the United States, gives the variation of the needle at various points on the western boundary of Pennsylvania. But as these observations are published in the Memoirs of the American Philosophical Society, they are not here repeated. Mr. Ellicott adds however, "the line of no variation in the United States at present, (1810,) crosses the west boundary of Pennsylvania, about thirty miles south of Lake Erie, and enters that lake near to Presque Isle."

Nicholas King, public surveyor, states the variation at Washington, Dec. 23, 1809, to have been 52′ W.

Bishop Madison of William and Mary's College, Williamsburg, Virginia, lat. 37° 15′, long. 76° 35′, states the variation there to have been 43′ E. 1809. Other observations about the same time made it 23′ E. In 1694, the variation was 5° W. At Norfolk, lat. 36° 51′, long. 76°, he found no variation in 1809. At Richmond, lat. 37° 27′, long. 77° 25′, nearly 57′ E. In 1728, on the boundary between Virginia and North Carolina, lat. 36° 31′, long. 76°, nearly, the variation was settled at 3° W. In 1732, at Cape Henry, lat. 37°, long. 75½°, the variation was 4° 40′ W.

Jonathan Price, of Newbern, N. C., lat. 35° 7′ N., states the variation of the needle to have been there, in 1796, 2° 40′ E.; in 1806, it was less than 2° E., and in 1809, he found it 1° 45′ E.

Jared Mansfield, Surveyor General of the United States, gives the following observations:

| | | |
|---|---|---|
| “ S. E. corner of Western Reserve, lat. 41° N., long. 80° 37′ W., | variation, | 1° 21′ E. |
| 10 miles west on the same parallel of latitude, | “ | 1 37 |
| 20 “ “ “ | “ | 1 48 |
| 33 “ “ “ | “ | 2 4 |
| 43 “ “ “ | “ | 2 22 |
| 57 “ “ “ | “ | 2 30 |
| 123 “ “ “ | “ | 3 57 |
| In latitude 40° 55′ and longitude 81° 48′, | “ | 2 36 |
| Marietta, lat. 39° 25′, long. 81° 26′ W. | “ | 2 36 |
| Detroit, lat. 42° 30′, long. 82° 56′, | “ | 2 48 |
| Rapids of the Miami, lat. 41° 30′, long. 83° 30′, | “ | 3 25 |
| Fort Defiance, lat. 41° 15′, long. 84° 23′, | “ | 4 30 |
| Cincinnati, lat. 39° 7′, long. 84° 27′, | “ | 5 0 |
| Mouth of Miami River, lat. 39° 8′, long. 84° 45′, | “ | 5 10 |
| Latitude 38° 45′ N., longitude 85° 15′ W., | “ | 5 25 |
| Latitude 38° 10′, longitude 86° 30′, | “ | 6 30 |
| Near the Falls of the Ohio, lat. 38° 20′ N., long. 85° 40′ W., | “ | 5 50 |
| Vincennes, lat. 38° 42′, long. 87° 20′, | “ | 6 45 |
| 11 miles north of the mouth of the Wabash River, | “ | 7 10 |
| Mouth of the Ohio River, lat. 37° 4′, long. 89° W., | “ | 7 20 |
| Cahokia, Ill., lat. 38° 36′, long. 90° 9′, | “ | 8 25 |

Nearly all of the foregoing observations have been made within the four or five last years (from 1810.) They go to the establishment of a principle which will be found of considerable use to surveyors, viz. that the quantity of variation easterly in the same parallel, increases gradually and nearly equally in advancing westward at the rate of a degree in about 60 English miles."

Mr. Edward Livingston states that the first observation made in Louisiana by Father Laval, in 1720, determined the variation at New Orleans to be 2° E.; and that by sixty-two observations made by Lason in 1806, who employed in each six different needles, which made 372 observations, he had found a mean of 8° 2′ 39″ East variation.

The following were copied from the returns made to the Treasury department by the public surveyors.

| | | | | | |
|---|---|---|---|---|---|
| Mouth of the Scioto, - - | variation | 5° | | E. | in 1805. |
| Augusta, on the Ohio, - - | " | 5 | | E. | 1805. |
| Jeffersonville, - - | " | 6 | 45′ | E. | " |
| Natchez, - - - | " | 9 | | E. | 1802. |
| In Louisiana, lat. 31°, long. 92° 10′ W., | varia. | 9 | 20 | E. | 1807. |
| On the Washita river, lat. 34°, lon. about 92° W. | | 8 | 20 | E. | *1804. |
| Amelia Island, lat. 30° 44′, long. 81° 20′ W. | | 2 | | W. | 1775. |
| Mouth of St. Croix, lat. 45° 5′, long. 67° 12′, | | 12 | 19 | W. | 1797. |
| Pensacola, lat. 30° 25′, long. 87° 12′ W. | | 4 | 30 | E. | 1780. |
| Port Royal, S. C. long. 79° 30′ - - | | 3 | | E. | 1777. |
| Charleston, S. C. - - - | | 3 | 48 | E. | 1777. |
| Nantucket, - - - - | | 6 | 30 | W. | 1776. |
| Plymouth, - - - - | | 7 | | W. | 1776. |
| Boston Harbor, - - - - | | 7 | 40 | W. | 1776. |
| Penobscot Bay, - - - - | | 9 | | W. | |

Besides the preceding observations, few of which have ever been published, I have endeavored to collect together all the published observations I could find. In Douglass' History of the British Settlements in America, Vol. I, pages 270–2, is given the variation for several places in the United States; and in Kalm's Travels in North America, Vol. I, page 43, are given some more observations. In Samuel Williams's History of Vermont, 2d edition, 1809, is given a table of all the magnetic observations

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* By William Dunbar.

in the Eastern States with which he was acquainted; and in the Memoirs of the American Philosophical Society, as well as in those of the American Academy, various observations are recorded. The substance of all of these is given in the general table which follows.

In the Aurora, a paper published at Philadelphia, July 27, 1813, is a communication from David M'Clure, stating the variation in Philadelphia at that time to be 2° 25′ W. In the same paper for Sept. 12th, is a communication from Thomas Whitney, mathematical instrument maker, stating the following facts. It appears that the variation was here 8° 30′ W. in 1710. In 1793, it was observed by R. Brooks to be 1° 30′ W. In 1804, it was observed by several men of science to be 2° W. An anonymous communication in the same Journal for Sept. 15th, states the variation at Lewis, in Delaware, in 1795, to have been 55′ west.

The following facts I have learned from various sources. Mr. N. Goodwin, surveyor in Hartford, Ct., determined the variation at that place in 1824, to be 5° 45′ W.; in 1828, 6° 3′ W.; and in 1829, 6° 3′ W. He also determined the variation in New Haven for 1828 to be 5° 17′ W.

The variation at Pensacola, Florida, was stated to me in 1835, by an officer of the navy, to be 6° E.

The variation for New York is given at 4° 40′ W. in 1824, on Blunt's map of that year.

The variation at New Haven is also given at 5° 10′ W. in 1811, on a map of that city.

The variation at Montpelier, Vt., in 1829, was 12° 25′ W., as given in Executive Documents, Vol. IV, No. 190, page 23.

Variation at Kaskaskia, Ill., in 1809, 7° 20′ E., according to American State Papers—Public Lands, Vol. II, page 195.

Variation at Alton, Ill., was given me at 8° E. in 1835.

Variation at Athens, Ga., in 1837, 4° 31′ E., as determined by Prof. McCay.

Variation at South Hanover, Indiana, in 1837, 4° 35′ E., as determined by Prof. Dunn.

Variation at West Chester, Pa., in 1832, was 3° 25′ W., as observed by Prof. Bache.

The Annual Report of the Regents of the University of the State of New York for 1837, contains the observations made at eleven different places in the State. These are all to be found in our general table.

Dr. H. H. Sherwood, of New York city, has politely furnished me with several statements of the declination in different parts of the country, which are also incorporated in the table.

Besides the preceding, I have been furnished with various additional observations, by the kind assistance of Mr. E. C. Herrick, of New Haven. Some of these are extracted from "Long's Expedition to the Rocky Mountains," and "Long's Expedition to the Source of St. Peter's River." These are all to be found in our general table, and need not be repeated here. The remaining observations are as follows: Mr. Jedediah Herrick, of Hampden, Penobscot county, Maine, in a letter of April, 1837, says: "Thirty-two years ago, I found the declination at this place, by an ordinary semicircle, 11¼° W., and, during the past month, have made a series of observations with a better instrument and much care. Declination 13° 4′ W. In 1825, at the Forks of the Penobscot, lat. 45° 30′, found the declination 14° 45′ W."

An almanac, by Nathan Wilde, for 1836, published at Keene, N. H., contains the declination of the needle for each year, from 1812 to 1836. The observations were made by Mr. Wilde with a needle two feet long, at Chesterfield, lat. 42° 53′, long. 72° 20′. They are all shown in our table. In June, 1837, the variation at the same place was determined, by Mr. A. C. Twining, to be 8° 5′.

The variation at Barton, Vt., was determined July 8, 1837, in the evening, at 10° 51′ W., by Mr. Twining; and at St. Johnsbury, July 22, 1837, at 11 P. M., 9° 16′ W.

At Burlington, Vt., the variation is stated by Prof. Benedict at 9° 45′, or 9° 50′ W.

The Gazette and Mercury, published at Greenfield, Mass., Dec. 19, 1837, states: "It has recently been determined in Deerfield, Mass., by a number of observations with accurate instruments, that the variation of the needle is at present 7° 57′ W."

At New York city, about three years ago, the variation was 4° 50′ W., as stated by Mr. W. C. Redfield.

Mr. G. C. Schaeffer, of New York city, states that Prof. Renwick, of Columbia College, determined the magnetic variation in the summer of 1837 at Constable's Point, about five miles S. W. of the City Hall, under favorable circumstances, being on a sandy point, far away from local attraction. Variation, 5° 40′ W.

At Philadelphia, Sept. 1837, variation 3° 52′ W., as stated by Mr. Walter R. Johnson.

In the preceding enumeration, I have not included a table of magnetic variations which is given in Vol. xvi, page 63, of this Journal. This table professes to give the variation of the needle at intervals generally of five years, from 1673 to 1800, for Boston, Falmouth, and Penobscot. I have rejected the table, because I am satisfied it is a *calculated* table. This assertion will sound strange to some, for I have more than once been referred to it by men of science, as a repository of exceedingly valuable observations, and they seem never to have suspected that the observations were not genuine. But there is no room for the shadow of a doubt, that those numbers were mostly *calculated.* The evidence is as follows: The table is a very old one, being found in the Almanac for 1771, by Nathaniel Ames. A copy of this almanac is in possession of Mr. William Lyon, of New Haven. There is also in the possession of Mr. Adam Winthrop, of Louisiana, grandson of Prof. Winthrop of Harvard University, a small printed sheet, in the form of a handbill, containing the same table. It is without date, but bears marks of age, and was found among the papers of Prof. Winthrop. It is my opinion that this is the original from which the table in the almanac was copied, and as it is a document to which circumstances have given considerable consequence, I have here transcribed it verbatim. "A table, exhibiting the variation of the compass in Boston and the parts adjacent, from the earliest accounts of it to the end of the 18th century; agreeable to the actual Observations distinguished by Obs. By John Winthrop, Esq., Hollisian Professor of Mathematics at Harvard College, in Cambridge, in New England.

| Years. | Variation at Boston. | Falmouth. | Penobscot. |
|---|---|---|---|
| 1673 | 11° 15′ | 12° 00′ | 12° 08′ |
| 1678 | 11 0 | 11 45 | 11 53 |
| 1689 | 10 30 | 11 15 | 11 23 |
| 1700 | 10 0 Obs. | 10 45 | 10 53 |
| 1705 | 9 46 | 10 31 | 10 39 |
| 1710 | 9 32 | 10 17 | 10 25 |
| 1715 | 9 18 | 10 3 | 10 11 |
| 1720 | 9 5 | 9 50 | 9 58 |
| 1725 | 8 51 | 9 36 | 9 44 |
| 1730 | 8 37 | 9 22 | 9 30 |
| 1735 | 8 23 | 9 8 | 9 16 |
| 1742 | 8 0 Obs. | 8 45 | 8 53 |

| Years. | Variation at Boston. | Falmouth. | Penobscot. |
|---|---|---|---|
| 1745 | 7° 56′ | 8° 41′ | 8° 49′ |
| 1750 | 7 42 | 8 27 | 8 35 |
| 1757 | 7 20 Obs. | 8 5 | 8 13 |
| 1761 | 7 7 | 7 52 | 8 0 Obs. |
| 1763 | 7 0 Obs. | 7 45 Obs. | 7 53 |
| 1770 | 6 46 | 7 31 | 7 39 |
| 1775 | 6 32 | 7 17 | 7 25 |
| 1780 | 6 18 | 7 3 | 7 11 |
| 1785 | 6 4 | 6 49 | 6 57 |
| 1790 | 5 50 | 6 35 | 6 43 |
| 1795 | 5 36 | 6 21 | 6 29 |
| 1800 | 5 22 | 6 7 | 6 15" |

The table which is given in Ames's Almanac for 1771, is exactly like the preceding, with six exceptions, viz. the variations for Boston are given 9° 45′ for 9° 46′; 8° 57′ for 8° 51′; 6° 45′ for 6° 46′; and 5° 35′ for 5° 36′. In the column for Falmouth is given 10° 12′ for 10° 17′, and in the column for Penobscot 8° 32′ for 8° 35′. I have no doubt that these were typographical errors in the almanac, and that the sheet in the possession of Mr. Adam Winthrop, which was doubtless printed under the eye of Prof. Winthrop, is the correct copy. It is evident that the preceding table was entirely *computed*, with the exception of those numbers marked Obs. For (1.) the table was published before 1771. One quarter of the numbers were then certainly computed. (2.) The variations for Falmouth are constantly 45′ greater than those for Boston, and those for Penobscot 8′ greater than those for Falmouth. To one who has ever made magnetic observations, this will amount to an absolute demonstration that those numbers were never observed. (3.) The observations from 1700 to 1800, with the exception of those marked *Obs.*, all occur at intervals of five years, and the change of declination for this period is constantly 14′ or 15′. The observations of 1742 and 1763, showing a change of one degree in 21 years, or somewhat more than 14′ in five years, doubtless furnished the data for the table. (4.) Penobscot and Falmouth, during the first years contained in the table, were small settlements. Penobscot was little more than a military post, and Falmouth was devastated by the Indians in 1692, and the town entirely broken up. The inhabitants did not return until about 1708. Who then is this indefatigable observer, that, with clock-like regularity, at the expiration of every five years, returns to measure the magnetic variation; and how does his zeal reprove the sluggishness of the scientific institutions in our country, at many of which the variation of the needle has not been even once observed? (5.) The table does not purport to be *a table of observations*, but to be "*agreeable* to the actual observations distinguished by Obs." The numbers marked Obs. were then observed, and the others were computed from them, so that six observations were the foundation of the whole table. The matter appears to me so plain, that it seems useless to argue the question further. The table which is given in volume sixteenth of this Journal, has copied the errors of Ames's almanac, and thus, by introducing a little irregularity into the numbers, has given them more the air of actual observations. The table is still further disguised, by omitting the *Obs.* which marks certain numbers in the original table. If now I have succeeded in showing that this "interesting document," as Mr. De Witt terms it, contains but six actual observations, I shall consider that I have effected no small object; for it certainly is a fact not very creditable to American science, that a table which Prof. Winthrop, nearly three quarters of a century ago, computed for his own amusement, should now be referred to as composed of genuine observations. I have taken the more pains to expose this imposition, (for imposition I think it may be called, although a perfectly honest one on the part of Prof. Winthrop,) because it is necessary to be particularly on our guard against confounding *calculations* with observations, and because in the progress of my investigations, I have met with other tables similar to the preceding one of Prof. Winthrop.

I have now mentioned all the new magnetic observations which I have been able to collect, and have also stated where other published observations are recorded. The results of all these are embraced in the following general table:

***Table**, exhibiting the Variation of the Magnetic Needle in different parts of the United States, from the first settlement of the country.*

| Place. | Lat. N. | | Lon. W. | | Variation. | | Date. | Authority. |
|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ° | ′ | ° | ′ | | |
| MAINE. | | | | | | | | |
| N. boundary of State, | 48 | 1 | 67 | 55 | 17 | 45 w. | 1818 | Mr. John Johnson. |
| Timiscuata Lake, | 47 | 38 | 69 | 0 | 16 | 31 | 1818 | “ “ |
| Matwaska, | 47 | 12 | 68 | 10 | 16 | 45 | 1818 | “ “ |
| Source of the St. Croix, | 45 | 55 | 67 | 55 | 14 | 0 | 1817 | “ “ |
| Forks of Penobscot, | 45 | 30 | 68 | 30 | 14 | 45 | 1825 | Mr. J. Herrick. |
| Mouth of the St. Croix, | 45 | 5 | 67 | 12 | 12 | 19 | 1797 | Chart. |
| Hampden, | 44 | 40 | 68 | 55 | 11 | 15 | 1805 | Mr. J. Herrick. |
| “ | “ | “ | “ | “ | 13 | 4 | 1837 | “ “ |
| Pownal, | 43 | 51 | 70 | 10 | 8 | 0 | 1761 | Prof. Winthrop. |
| Falmouth, | 43 | 39 | 70 | 19 | 7 | 45 | 1763 | “ “ |
| Kittery, | 43 | 6 | 70 | 35 | 7 | 46 | 1771 | Holland. |
| NEW HAMPSHIRE. | | | | | | | | |
| Hanover, | 43 | 41 | 72 | 10 | 7 | 0 | 1765 | Pres. Wheelock. |
| “ | “ | “ | “ | “ | 4 | 15 | 1810 | “ “ |
| Portsmouth, | 43 | 5 | 70 | 45 | 7 | 48 | 1771 | Holland. |
| Chesterfield, | 42 | 53 | 72 | 20 | 6 | 26 | 1812 | Nathan Wilde. |
| “ | “ | “ | “ | “ | 6 | 25 | 1813 | “ “ |
| “ | “ | “ | “ | “ | 6 | 17 | 1814 | “ “ |
| “ | “ | “ | “ | “ | 6 | 7 | 1815 | “ “ |
| “ | “ | “ | “ | “ | 6 | 3 | 1816 | “ “ |
| “ | “ | “ | “ | “ | 6 | 2 | 1817 | “ “ |
| “ | “ | “ | “ | “ | 6 | 0 | 1818 | “ “ |
| “ | “ | “ | “ | “ | 6 | 3 | 1819 | “ “ |
| “ | “ | “ | “ | “ | 6 | 0 | 1820 | “ “ |
| “ | “ | “ | “ | “ | 6 | 7 | 1821 | “ “ |
| “ | “ | “ | “ | “ | 6 | 12 | 1822 | “ “ |
| “ | “ | “ | “ | “ | 6 | 30 | 1823 | “ “ |
| “ | “ | “ | “ | “ | 6 | 40 | 1824 | “ “ |
| “ | “ | “ | “ | “ | 6 | 35 | 1825 | “ “ |
| “ | “ | “ | “ | “ | 6 | 35 | 1826 | “ “ |
| “ | “ | “ | “ | “ | 6 | 45 | 1827 | “ “ |
| “ | “ | “ | “ | “ | 6 | 52 | 1828 | “ “ |
| “ | “ | “ | “ | “ | 7 | 0 | 1829 | “ “ |
| “ | “ | “ | “ | “ | 7 | 6 | 1830 | “ “ |
| “ | “ | “ | “ | “ | 7 | 10 | 1831 | “ “ |
| “ | “ | “ | “ | “ | 7 | 15 | 1832 | “ “ |
| “ | “ | “ | “ | “ | 7 | 30 | 1833 | “ “ |
| “ | “ | “ | “ | “ | 7 | 35 | 1834 | “ “ |
| “ | “ | “ | “ | “ | 7 | 40 | 1835 | “ “ |
| “ | “ | “ | “ | “ | 7 | 45 | 1836 | “ “ |
| “ | “ | “ | “ | “ | 8 | 5 | 1837 | Mr. A. C. Twining. |
| Hinsdale, | 42 | 46 | 72 | 17 | 6 | 0 | 1772 | Wright. |
| VERMONT. | | | | | | | | |
| Barton, | 44 | 44 | 72 | 3 | 10 | 51 | 1837 | Mr. A. C. Twining. |
| Burlington, | 44 | 28 | 73 | 14 | 7 | 38 | 1793 | Dr. Williams. |
| “ | “ | “ | “ | “ | 7 | 30 | 1818 | Mr. John Johnson. |

| Place. | Lat. N. | | Lon. W. | | Variation. | | Date. | Authority. |
|---|---|---|---|---|---|---|---|---|
| | ° | ' | ° | ' | ° | ' | | |
| VERMONT. | | | | | | | | |
| Burlington, | 44 | 28 | 73 | 14 | 7 | 42 w. | 1822 | Mr. John Johnson. |
| “ | “ | “ | “ | “ | 8 | 10 | 1830 | “ “ |
| “ | “ | “ | “ | “ | 8 | 15 | 1831 | “ “ |
| “ | “ | “ | “ | “ | 8 | 25 | 1832 | “ “ |
| “ | “ | “ | “ | “ | 8 | 50 | 1834 | “ “ |
| “ | “ | “ | “ | “ | 9 | 45 | 1837 | Prof. Benedict. |
| St. Johnsbury, | 44 | 26 | 71 | 55 | 9 | 16 | 1837 | Mr. A. C. Twining. |
| Montpelier, | 44 | 17 | 72 | 36 | 12 | 25 | 1829 | Executive Doc'ts. |
| Ryegate, | 44 | 10 | 72 | 10 | 7 | 0 | 1801 | James Whitlaw. |
| Rutland, | 43 | 37 | 72 | 46 | 7 | 3 | 1789 | Dr. Williams. |
| “ | “ | “ | “ | “ | 6 | 4 | 1810 | “ “ |
| “ | “ | “ | “ | “ | 6 | 1 | 1811 | “ “ |
| Pownal, | 42 | 46 | 72 | 59 | 5 | 52 | 1786 | “ “ |
| MASSACHUSETTS. | | | | | | | | |
| Newburyport, | 42 | 48 | 70 | 52 | 7 | 18 | 1781 | “ “ |
| Williamstown, | 42 | 45 | 73 | 15 | 5 | 52 | 1786 | “ “ |
| Deerfield, | 42 | 34 | 72 | 29 | 5 | 28 | 1811 | Prof. Hitchcock. |
| “ | “ | “ | “ | “ | 7 | 57 | 1837 | Gaz. and Mercury. |
| Salem, | 42 | 31 | 70 | 54 | 7 | 2 | 1781 | Pres. Willard. |
| “ | “ | “ | “ | “ | 5 | 57 | 1805 | Dr. Bowditch. |
| “ | “ | “ | “ | “ | 5 | 20 | 1808 | “ “ |
| “ | “ | “ | “ | “ | 6 | 22 | 1810 | “ “ |
| Cambridge, | 42 | 22 | 71 | 7 | 7 | 30 | 1810 | Prof. Farrar. |
| “ | “ | “ | “ | “ | 8 | 51 | 1835 | “ “ |
| Boston, | 42 | 21 | 71 | 4 | 9 | 0 | 1708 | Mr. Brattle. |
| “ | “ | “ | “ | “ | 8 | 0 | 1742 | Prof. Winthrop. |
| “ | “ | “ | “ | “ | 7 | 20 | 1757 | “ “ |
| “ | “ | “ | “ | “ | 7 | 14 | 1761 | Dr. Williams. |
| “ | “ | “ | “ | “ | 7 | 0 | 1763 | Prof. Winthrop. |
| “ | “ | “ | “ | “ | 6 | 46 | 1782 | Dr. Williams. |
| “ | “ | “ | “ | “ | 6 | 38 | 1788 | “ “ |
| Plymouth, | 41 | 57 | 70 | 41 | 7 | 0 | 1776 | Chart. |
| Nantucket, | 41 | 17 | 70 | 6 | 6 | 30 | 1776 | “ |
| RHODE ISLAND. | | | | | | | | |
| Providence, | 41 | 49 | 71 | 26 | 6 | 30 | 1769 | Dr. West. |
| Newport, | 41 | 29 | 71 | 21 | 6 | 0 | 1776 | Chart. |
| CONNECTICUT. | | | | | | | | |
| Pomfret, | 41 | 52 | 71 | 57 | 5 | 5 | 1810 | Asher Miller. |
| East Hartford, | 41 | 46 | 72 | 48 | 4 | 46 | 1810 | “ “ |
| Hartford, | 41 | 46 | 72 | 40 | 5 | 25 | 1786 | Dr. Williams. |
| “ | “ | “ | “ | “ | 5 | 45 | 1824 | N. Goodwin. |
| “ | “ | “ | “ | “ | 6 | 3 | 1828 | “ “ |
| “ | “ | “ | “ | “ | 6 | 3 | 1829 | “ “ |
| Hebron, | 41 | 38 | 72 | 18 | 4 | 50 | 1805 | George Gillet. |
| “ | “ | “ | “ | “ | 6 | 10 | 1835 | “ “ |
| Danbury, | 41 | 22 | 73 | 23 | 5 | 41 | 1810 | Asher Miller. |
| Lyme, | 41 | 18 | 72 | 17 | 4 | 30 | 1810 | “ “ |
| New Haven, | 41 | 18 | 72 | 58 | 5 | 47 | 1761 | Pres. Stiles. |
| “ “ | “ | “ | “ | “ | 5 | 25 | 1775 | Prof. Strong. |

| Place. | Lat. N. | | Lon. W. | | Variation. | | Date. | Authority. |
|---|---|---|---|---|---|---|---|---|
| | ° | ' | ° | ' | ° | ' | | |
| CONNECTICUT. | | | | | | | | |
| New Haven, | 41 | 18 | 72 | 58 | 5 | 15 w. | 1780 | Pres. Stiles. |
| “ “ | “ | “ | “ | “ | 5 | 10 | 1811 | Nathan Redfield. |
| “ “ | “ | “ | “ | “ | 4 | 35 | 1819 | Prof. Fisher. |
| “ “ | “ | “ | “ | “ | 5 | 17 | 1828 | N. Goodwin. |
| “ “ | “ | “ | “ | “ | 5 | 52 | 1835 | Prof. Loomis. |
| “ “ | “ | “ | “ | “ | 5 | 55 | 1836 | Mr. E. C. Herrick. |
| NEW YORK. | | | | | | | | |
| Potsdam, | 44 | 40 | 75 | 1 | 7 | 25 | 1835 | Regents' Report. |
| Utica, | 43 | 6 | 75 | 13 | 4 | 10 | 1834 | “ “ |
| “ | “ | “ | “ | “ | 3 | 35 | 1836 | “ “ |
| Johnstown, | 43 | 0 | 74 | 23 | 6 | 2 | 1818 | “ “ |
| Cazenovia, | 42 | 55 | 75 | 51 | 3 | 25 | 1834 | “ “ |
| Auburn, | 42 | 55 | 76 | 28 | 3 | 43 | 1833 | “ “ |
| Buffalo, | 42 | 53 | 78 | 55 | 1 | 25 | 1837 | Mr. R. W. Haskins. |
| Geneva, | 42 | 52 | 77 | 5 | 3 | 49 | 1833 | Regents' Report. |
| Albany, | 42 | 39 | 73 | 44 | 5 | 44 | 1817 | Mr. De Witt. |
| “ | “ | “ | “ | “ | 5 | 45 | 1818 | “ “ |
| “ | “ | “ | “ | “ | 6 | 0 | 1825 | “ “ |
| “ | “ | “ | “ | “ | 6 | 40 | 1834 | Regents' Report. |
| “ | “ | “ | “ | “ | 6 | 47 | 1836 | “ “ |
| Oxford, | 42 | 28 | 75 | 33 | 3 | 52 | 1834 | “ “ |
| “ | “ | “ | “ | “ | 4 | 9 | 1836 | “ “ |
| Ithaca, | 42 | 27 | 76 | 30 | 2 | 51 | 1833 | “ “ |
| Oblong, | 42 | 3 | 73 | 30 | 5 | 3 | 1786 | Dr. Williams. |
| West Point, | 41 | 25 | 73 | 56 | 6 | 32 | 1835 | Prof. C. Davies. |
| East Hampton, | 41 | 0 | 72 | 19 | 6 | 8 | 1834 | Regents' Report. |
| New York City, | 40 | 43 | 74 | 1 | 8 | 45 | 1686 | Mr. Welles. |
| “ “ | “ | “ | “ | “ | 7 | 20 | 1723 | Geo. Burnet. |
| “ “ | “ | “ | “ | “ | 6 | 22 | 1750 | Mr. Alexander. |
| “ “ | “ | “ | “ | “ | 5 | 0 | 1755 | Evans. |
| “ “ | “ | “ | “ | “ | 4 | 20 | 1789 | Encyc. Met. |
| “ “ | “ | “ | “ | “ | 4 | 40 | 1824 | Blunt's Map. |
| “ “ | “ | “ | “ | “ | 4 | 50 | 1834 | Capt. Owen. |
| “ “ | “ | “ | “ | “ | 5 | 40 | 1837 | Prof. Renwick. |
| Jamaica, | 40 | 41 | 73 | 56 | 4 | 0 | 1835 | Regents' Report. |
| Flatbush, | 40 | 37 | 73 | 58 | 4 | 25 | 1834 | “ “ |
| “ | “ | “ | “ | “ | 4 | 45 | 1835 | “ “ |
| NEW JERSEY. | | | | | | | | |
| Princeton, | 40 | 22 | 74 | 35 | 7 | 0 | 1810 | Pres. Smith. |
| PENNSYLVANIA. | | | | | | | | |
| W. boundary of state, | 41 | 8 | 80 | 27 | | 25 E. | 1786 | Andrew Ellicott. |
| “ “ | 41 | 0 | “ | “ | | 19 E. | “ | “ “ |
| “ “ | 40 | 50 | “ | “ | | 17 E. | “ | “ “ |
| “ “ | 40 | 42 | “ | “ | | 51 E. | “ | “ “ |
| “ “ | 40 | 14 | “ | “ | 1 | 7 E. | “ | “ “ |
| “ “ | 39 | 59 | “ | “ | 1 | 12 E. | “ | “ “ |
| “ “ | 39 | 51 | “ | “ | 2 | 10 E. | “ | “ “ |
| Norriton, | 40 | 10 | 75 | 26 | 3 | 8 w. | 1770 | W. Smith. |
| Philadelphia, | 39 | 57 | 75 | 11 | 8 | 30 w. | 1710 | Thomas Whitney. |

| Place. | Lat. N. | | Lon. W. | | Variation. | | Date. | Authority. |
|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ° | ′ | ° | ′ | | |
| PENNSYLVANIA. | | | | | | | | |
| Philadelphia, | 39 | 57 | 75 | 11 | 5 | 45 w. | 1750 | Kalm's Travels. |
| “ | “ | “ | “ | “ | 1 | 30 | 1793 | Thomas Whitney. |
| “ | “ | “ | “ | “ | 2 | 0 | 1804 | “ “ |
| “ | “ | “ | “ | “ | 2 | 25 | 1813 | David M'Clure. |
| “ | “ | “ | “ | “ | 3 | 52 | 1837 | Walter R. Johnson. |
| West Chester, | 39 | 57 | 75 | 41 | 3 | 25 | 1832 | Prof. Bache. |
| DELAWARE. | | | | | | | | |
| Lewistown, | 38 | 44 | 75 | 0 | | 55 | 1795 | Aurora. |
| *Washington City,* | 38 | 53 | 77 | 2 | | 52 | 1809 | Nicholas King. |
| VIRGINIA. | | | | | | | | |
| Charlottesville, | 38 | 2 | 78 | 31 | 0 | 0 | 1835 | Prof. Patterson. |
| Richmond, | 37 | 32 | 77 | 25 | | 57 E. | 1809 | Pres. Madison. |
| Williamsburg, | 37 | 15 | 76 | 35 | 5 | 0 w. | 1694 | “ “ |
| “ | “ | “ | “ | “ | | 50 w. | 1780 | “ “ |
| “ | “ | “ | “ | “ | | 33 E. | 1809 | “ “ |
| Cape Henry, | 37 | 0 | 75 | 30 | 4 | 40 w. | 1732 | Douglass' History. |
| Norfolk, | 36 | 51 | 76 | 19 | 0 | 0 | 1809 | Pres. Madison. |
| S. boundary of state, | 36 | 31 | 76 | 0 | 3 | 0 w. | 1728 | Commissioners. |
| NORTH CAROLINA. | | | | | | | | |
| Newbern, | 35 | 20 | 77 | 5 | 2 | 40 E. | 1796 | Jonathan Price. |
| “ | “ | “ | “ | “ | 2 | 0 E. | 1806 | “ “ |
| “ | “ | “ | “ | “ | 1 | 45 E. | 1809 | “ “ |
| SOUTH CAROLINA. | | | | | | | | |
| Charleston, | 32 | 47 | 79 | 57 | 3 | 48 E. | 1777 | Chart. |
| “ | “ | “ | “ | “ | 2 | 54 E. | 1837 | Capt. Missroom. |
| GEORGIA. | | | | | | | | |
| Athens, | 34 | 0 | 83 | 20 | 4 | 31 E. | 1837 | Prof. McCay. |
| Milledgeville, | 33 | 7 | 83 | 20 | 5 | 30 E. | 1805 | John Bethune. |
| “ | “ | “ | “ | “ | 4 | 40 E. | 1835 | “ “ |
| FLORIDA. | | | | | | | | |
| Pensacola, | 30 | 28 | 87 | 12 | 6 | 0 E. | 1835 | Officer of Navy. |
| Tallahassee, | 30 | 27 | 84 | 36 | 5 | 12 E. | 1835 | Mr. P. Mitchel. |
| ALABAMA. | | | | | | | | |
| Florence, | 34 | 50 | 87 | 47 | 6 | 35 E. | 1818 | James H. Weakly. |
| “ | “ | “ | “ | “ | 6 | 28 E. | 1835 | “ “ |
| Mobile, | 30 | 40 | 88 | 11 | 8 | 10 E. | 1809 | “ “ |
| “ | “ | “ | “ | “ | 7 | 12 E. | 1835 | “ “ |
| MISSISSIPPI. | | | | | | | | |
| Natchez, | 31 | 34 | 91 | 25 | 9 | 0 E. | 1802 | Mr. Dunbar. |
| LOUISIANA. | | | | | | | | |
| Cheneyville, | 31 | 0 | 92 | 15 | 9 | 20 E. | 1807 | Public Surveys. |
| New Orleans, | 29 | 58 | 90 | 7 | 2 | 0 E. | 1720 | Laval. |
| “ “ | “ | “ | “ | “ | 8 | 3 E. | 1806 | Lason. |
| ARKANSAS. | | | | | | | | |
| Wachita River, | 34 | 0 | 92 | 0 | 8 | 20 E. | 1804 | Wm. Dunbar. |
| TENNESSEE. | | | | | | | | |
| Nashville, | 36 | 10 | 86 | 49 | 6 | 50 E. | 1829 | Prof. Hamilton. |
| “ | “ | “ | “ | “ | 7 | 7 E. | 1835 | “ “ |

| Place. | Lat. N. | | Lon. W. | | Variation. | | Date. | Authority. |
|---|---|---|---|---|---|---|---|---|
| | ° | ′ | ° | ′ | ° | ′ | | |
| KENTUCKY. | | | | | | | | |
| Augusta, | 38 | 50 | 83 | 50 | 5 | 0 E. | 1805 | Public Surveys. |
| OHIO. | | | | | | | | |
| Rapids of Maumee, | 41 | 39 | 83 | 30 | 2 | 48 | 1810 | Jared Mansfield. |
| Hudson, | 41 | 13 | 81 | 30 | 1 | 14 | 1837 | Prof. Loomis. |
| Defiance, | 41 | 15 | 84 | 23 | 4 | 30 | 1810 | Jared Mansfield. |
| Poland, | 41 | 0 | 80 | 37 | 1 | 21 | " | " " |
| Canfield, | 41 | 0 | 80 | 50 | 1 | 37 | " | " " |
| Berlin, | 41 | 0 | 81 | 3 | 1 | 48 | " | " " |
| Atwater, | 41 | 0 | 81 | 21 | 2 | 4 | " | " " |
| Suffield, | 41 | 0 | 81 | 34 | 2 | 22 | " | " " |
| Coventry, | 41 | 0 | 81 | 48 | 2 | 19 | " | " " |
| Norton, | 41 | 0 | 81 | 53 | 2 | 30 | " | " " |
| Seneca, | 41 | 0 | 83 | 20 | 3 | 57 | " | " " |
| Chippeway, | 40 | 55 | 81 | 48 | 2 | 36 | " | " " |
| Marietta, | 39 | 25 | 81 | 26 | 2 | 36 | " | " " |
| " | " | " | " | " | 1 | 29 | 1838 | Prof. Loomis. |
| Mouth of Miami river, | 39 | 8 | 84 | 45 | 5 | 10 | 1810 | Jared Mansfield. |
| Cincinnati, | 39 | 7 | 84 | 27 | 5 | 0 | " | " " |
| Portsmouth, | 38 | 48 | 82 | 50 | 5 | 0 | 1805 | Public Surveys. |
| INDIANA. | | | | | | | | |
| Madison, | 38 | 45 | 85 | 15 | 5 | 25 | 1810 | Jared Mansfield. |
| South Hanover, | 38 | 45 | 85 | 23 | 4 | 35 | 1837 | Prof. Dunn. |
| Vincennes, | 38 | 42 | 87 | 20 | 6 | 45 | 1810 | Jared Mansfield. |
| Falls of the Ohio, | 38 | 20 | 85 | 40 | 5 | 50 | " | " " |
| On the Ohio river, | 38 | 10 | 86 | 30 | 6 | 30 | " | " " |
| Mouth of the Wabash, | 38 | 0 | 88 | 0 | 7 | 10 | " | " " |
| ILLINOIS. | | | | | | | | |
| Chicago, | 42 | 0 | 87 | 40 | 6 | 12 | 1823 | Long's Expedition. |
| Jacksonville, | 39 | 45 | 90 | 18 | 8 | 45 | 1833 | Prof. Sturtevant. |
| Alton, | 38 | 52 | 90 | 12 | 8 | 0 | 1835 | Mr. Loomis. |
| Cahokia, | 38 | 36 | 90 | 9 | 8 | 25 | 1810 | Jared Mansfield. |
| Kaskaskia, | 37 | 57 | 89 | 55 | 7 | 20 | 1809 | Public Surveys. |
| Mouth of Ohio river, | 37 | 4 | 89 | 0 | 7 | 20 | 1809 | Jared Mansfield. |
| MISSOURI. | | | | | | | | |
| Franklin, | 38 | 57 | 92 | 57 | 11 | 42 | 1819 | Long's Expedition. |
| St. Louis, | 38 | 36 | 89 | 36 | 10 | 47 | " | " " |
| " | " | " | " | " | 8 | 49 | 1835 | Col. Nicolls. |
| MICHIGAN. | | | | | | | | |
| Detroit, | 42 | 30 | 82 | 58 | 2 | 48 | 1810 | Jared Mansfield. |
| MISSOURI & WISC. TER'S. | | | | | | | | |
| Lake of the Woods, | 49 | 0 | 94 | 0 | 11 | 1 | 1823 | Long's Ex. St. Peter's. |
| Camp Monroe, | 48 | 59 | | | 13 | 17 | " | " " |
| Island in Rainy Lake, | 48 | 35 | 92 | 30 | 8 | 15 | " | " " |
| N. coast of L. Superior | 47 | 58 | 90 | 0 | 6 | 21 | " | " " |
| Fort of Colum. Fir Co. | 45 | 39 | 96 | 34 | 12 | 29 | " | " " |
| Mouth of St. Peter's R. | 44 | 53 | 93 | 8 | 10 | 29 | " | " " |
| Encamp. on St. Peter's | 44 | 41 | 97 | 0 | 12 | 21 | " | " " |
| Fort Crawford, | 43 | 3 | 90 | 52 | 8 | 49 | " | " " |
| Engineer Cantonment, | 41 | 25 | 95 | 44 | 12 | 59 | 1819 | Long's Exp. Rocky Mts. |
| Cow Island, | 39 | 25 | 94 | 0 | 11 | 32 | " | " " |

From an attentive examination of the preceding table it will be seen, that from the time of the earliest observations down to about the commencement of the present century, the westerly variation was decreasing and the easterly increasing in every part of the United States; that more recently, the reverse has taken place, that is, that a retrograde movement of the needle has commenced. The precise year when this change took place cannot be certainly known. To determine this, we need more numerous and more accurate observations. All the observations, however, agree in this, that the change began as early as 1819, while the Philadelphia observations would make it as early as 1793, and those at Newbern, N. C. not far from the same year. The annual motion is much greater in the eastern states than in the south and west. I have carefully compared all the observations contained in the preceding table, and without giving the particulars of this discussion, will state at once the conclusion at which I have arrived, viz. that *the westerly variation is at present increasing and the easterly diminishing in every part of the United States; that this change commenced between the years* 1793 *and* 1819, *probably not every where simultaneously; and that the present annual change of variation is about 2′ in the southern and western states, from 3′ to 4′ in the middle states, and from 5′ to 7′ in the New England states.*

Having thus assembled together all the observations in my power, and deduced from them as far as possible the law of the needle's motion, it remained to reduce all the observations to one epoch, 1838, by applying the correction for the annual motion. They were then all carefully marked down upon a map of the United States, and the probable position of the lines of equal variation determined. Where no particular reason has been perceived to distinguish between the observations, the lines have been so drawn as to make the positive equal to the negative errors. This chart then is intended to represent all the observations contained in the preceding table reduced to the present time. In making this comparison some of the observations were found to present strange anomalies. Of these, the most considerable are the observations at Hanover, N. H. for 1810, those at Montpelier, Vt., and at Princeton, N. J. The first of these, according to my chart, is too small by nearly three degrees; and the others too large by nearly four degrees. I infer that either they were very bad observations, or were very much influenced by local attraction. This chart can of course lay claim to no greater accuracy than that to which the individual observations are entitled; yet it has the advantage of presenting to the eye at one view a distinct summary of all the observations, and moreover it shows at a glance the approximate variation at places where observations have never been taken. It is of course desirable that the chart should be verified as extensively as may be, and if it should be the means of stimulating a single individual to undertake a series of accurate magnetic observations, taking care to present them to the public, the labor which this work has cost me will not have been expended altogether in vain.

I had originally contemplated merely a collection of observations on the variation of the needle. In the course of my inquiries, however, I met with a few observations of the dip, and concluded to unite them all in the same article. All which I have been able to collect are contained in the following table. Those made by Professors Bache and Courtenay are from the Transactions of the American Philosophical Society, Vol. V. New Series; those made at Cambridge are from the Memoirs of the American Academy, Vol. I. p. 68; those made by Sir John Franklin, Captains Sabine and Back, are given in the Philosophical Transactions of London; the observation at Charlottesville was communicated in a letter by Prof. Patterson; those in Ohio were received from Prof. Locke, of Cincinnati; and the remainder are from Long's Expedition to the Rocky Mountains in 1819 and 1820, and were furnished me by Mr. Herrick.

*Table exhibiting the Dip of the Magnetic Needle in different parts of the United States.*

| Place. | Lat. N. | | Lon. W. | | Dip. | | Date. | Authority. |
|---|---|---|---|---|---|---|---|---|
| MASSACHUSETTS. | ° | ′ | ° | ′ | ° | ′ | | |
| Cambridge, | 42 | 22 | 71 | 7 | 69 | 51 | 1780 | Mr. Williams. |
| “ | “ | “ | “ | “ | 69 | 41 | 1782 | “ “ |
| “ | “ | “ | “ | “ | 69 | 41 | 1783 | “ “ |
| Springfield, | 42 | 6 | 72 | 36 | 74 | 11 | 1834 | Prof. Bache. |
| RHODE ISLAND. | | | | | | | | |
| Providence, | 41 | 49 | 71 | 25 | 74 | 3 | 1834 | “ “ |
| NEW YORK. | | | | | | | | |
| Albany, | 42 | 39 | 73 | 45 | 74 | 51 | 1833 | Profs. Henry and Cram. |
| “ | “ | “ | “ | “ | 74 | 40 | 1834 | Prof. Bache. |
| West Point, | 41 | 23 | 74 | 1 | 73 | 26 | 1833 | Courtenay and Henry. |
| “ | “ | “ | “ | “ | 73 | 37 | 1834 | Prof. Courtenay. |
| New York City, | 40 | 43 | 74 | 1 | 73 | 5 | 1822 | Capt. Sabine. |
| “ | “ | “ | “ | “ | 73 | 27 | 1825 | Sir John Franklin. |
| “ | “ | “ | “ | “ | 72 | 49 | 1834 | Capt. Back. |
| “ | “ | “ | “ | “ | 72 | 52 | 1834 | Prof. Bache. |
| PENNSYLVANIA. | | | | | | | | |
| Philadelphia, | 39 | 57 | 75 | 12 | 72 | 0 | 1834 | Bache and Courtenay. |
| Pittsburgh, | 40 | 32 | 80 | 2 | 78 | 12 | 1819 | Long's Expedition. |
| MARYLAND. | | | | | | | | |
| Baltimore, | 39 | 17 | 76 | 38 | 70 | 59 | 1834 | Prof. Courtenay. |
| VIRGINIA. | | | | | | | | |
| Charlottesville, | 38 | 2 | 78 | 31 | 71 | 9 | 1834 | Prof. Patterson. |
| OHIO. | | | | | | | | |
| Urbana, | 40 | 3 | 83 | 42 | 71 | 39 | 1838 | Prof. Locke. |
| Columbus, | 39 | 55 | 83 | 3 | 71 | 5 | 1838 | “ |
| Springfield, | 39 | 53 | 83 | 47 | 71 | 29 | 1838 | “ |
| Dayton, | 39 | 45 | 84 | 9 | 71 | 23 | 1838 | “ |
| Cincinnati, | 39 | 6 | 84 | 27 | 70 | 46 | 1838 | “ |
| KENTUCKY. | | | | | | | | |
| Shippingport, | 38 | 15 | 85 | 30 | 70 | 15 | 1819 | Long's Expedition. |
| MISSOURI. | | | | | | | | |
| Eng. Cantonment, | 41 | 25 | 95 | 44 | 71 | 7 | 1820 | “ “ |
| Cow Island, | 39 | 25 | 94 | 0 | 69 | 50 | 1819 | “ “ |
| Charaton, | 39 | 10 | 92 | 20 | 69 | 50 | 1819 | “ “ |
| Fort Osage, | 39 | 10 | 94 | 18 | 69 | 18 | 1819 | “ “ |
| Franklin, | 38 | 57 | 92 | 57 | 69 | 30 | 1819 | “ “ |
| St. Charles, | 38 | 46 | 89 | 48 | 70 | 5 | 1819 | “ “ |
| Belle Fontaine, | 38 | 43 | 89 | 36 | 70 | 0 | 1819 | “ “ |
| St. Louis, | 38 | 36 | 89 | 36 | 70 | 30 | 1819 | “ “ |
| Cote sans Dessein, | 38 | 36 | 91 | 56 | 70 | 50 | 1819 | “ “ |
| Merrimack river, | 38 | 26 | 89 | 36 | 70 | 0 | 1819 | “ “ |

From the preceding observations it seems impossible satisfactorily to determine what changes the dip of the needle has experienced in this country. From the course of the observations made in other places by Prof. Bache, it may be inferred that the dip in 1834 was at Cambridge 73° 33′, being an increase since 1783 of 3° 52′, or about four and a half minutes per year. It may be considered as established, that the dip has increased in this country since the earliest observations, but whether it is still increasing at the present time seems more uncertain. The observations made at Albany and New York may excite a suspicion that such is not the fact. It is hoped that so important a question will not long remain doubtful. From this table of observations I have laid down the lines of equal dip for every five degrees upon the chart as well as I was able. These lines being deduced from a small number of observations, can only be considered as very rough approximations to the truth, and lay no claim to great precision. The observation at Pittsburgh seems utterly irreconcilable with the others. I can only explain the difference by supposing it to be a wretched observation, or else that there was a very remarkable local attraction, or finally, that there is some typographical error. If we read 73° for 78° the observation will agree tolerably well with the others. Few observers in the United States have instruments suitable for determining the dip; yet it is to be hoped that such as are thus furnished will make a faithful use of them, so that we may soon be able to prepare a much more accurate magnetic chart of the United States than the one which is now presented to the public.

## ART. IV.—*On the Latitude and Longitude of Yale College Observatory;* by ELIAS LOOMIS, Professor of Mathematics and Natural Philosophy in Western Reserve College, Ohio.

IN the summer of 1835, being then at New Haven, I undertook a series of observations for determining the latitude and longitude of the College Observatory. The observations were made under many disadvantages, with instruments poorly calculated for the purpose; yet as it is believed that the results are more to be relied upon than those which have hitherto been adopted, they are here summarily presented to the public. I know of no attempt worth mentioning, which had ever been made to determine the latitude or longitude of the College before the year 1811. President Day, at that time made a few observations for the latitude, by means of the declination circle of a portable Equatorial, the mean of which was about 41° 18′; yet as this circle was graduated only to half degrees, and read by means of a vernier to minutes only, and the mean was derived from but twelve observations, this determination might be easily liable to an error of half a minute. President Day, assisted by Professor Kingsley, observed the solar eclipse of Sept. 17, 1811, with great care, and determined therefrom the longitude of the College 4h. 51m. 50s. This was doubtless a very good observation; yet as it was a solitary observation, and moreover the eclipse was not visible in Europe, the longitude deduced might still be erroneous to ten or fifteen seconds of time. There was therefore room to hope, that by additional observations, greater accuracy might be attained; and although the results I here present fall far short of my wishes, still, as I am no longer in a situation to prosecute them further, I have concluded to publish them.

The observations for the latitude were made with a sextant graduated to 10′, and reading by a vernier to 10″. The mean of fifty observations on Polaris made the latitude 41° 19′ 3.9″. The mean of thirty observations on southern stars made it 41° 17′ 51.1″. Mean of northern and southern stars, 41° 18′ 27.5″. Difference of the results from northern and southern stars, 1′ 12.8″. This difference must arise mainly from the error of graduation. I had anticipated such an error from the first, and therefore selected such southern stars as had about the same altitude with the pole-star, in order that all the observations might be made upon the same part of the arc. To test the instrument, I now selected two stars whose places were well known (α Cygni and α Bootis,) and from their right ascensions and declinations computed their angular distance from each other, which distance was very nearly equal to the double altitude of Polaris. I then watched the opportunity when they were both in the same vertical plane, and when, being on opposite sides of the zenith, the whole effect of refraction was to diminish their distance from each other. I made repeated and careful measurements of their distance on two successive evenings, which made the error of the instrument 1′ 11″, being very nearly the difference in the results from the northern and southern stars. This difference was not owing to index error, which had been carefully measured and allowed for, but was certainly an error of the graduation. The instrument was very neatly made, and I was not prepared to find so great an error; yet the sextant had received a blow by which the arc was slightly bent, and although it was subsequently straightened by an experienced workman, it would be by no means strange if the limb were still somewhat distorted. The deduced latitude, however, could not be greatly affected by this error, because the observations were all made upon nearly the same part of the limb, and this part was carefully tested. I take therefore 41° 18′ 28″ as the latitude of the Observatory, and think it improbable that this result should be five seconds in error.

To obtain the longitude, I made several observations of moon culminating stars. They were made with a small transit instrument, the same which is mentioned in Volume xxx. p. 214 of this Journal. As the instrument, from its position, commanded only a low range in altitude, it was impossible to observe the transits of the moon except at particular stages. The observations were for this reason much less numerous than they would otherwise have been. In Volume IX. of the Memoirs of the Royal Astronomical Society, pages 254—256, I find corresponding observations made on some of the nights at Greenwich, Cambridge, and Edinburgh. Each set of corresponding observations has furnished one determination of the longitude, as is shown in the following table:

GREENWICH AND NEW HAVEN.

| Date. 1835. | Observed increase of AR of Moon's first limb. | | Computed Difference of Meridians. | | |
|---|---|---|---|---|---|
| | m. | s. | h. | m. | s. |
| June 7 | 11 | 34.77 | 4 | 51 | 33 |
| " 8 | 12 | 21.79 | | | 45 |
| July 6 | 12 | 26.28 | | | 28 |
| " 7 | 13 | 13.42 | | | 43 |
| August 4 | 13 | 10.94 | | | 44 |

CAMBRIDGE AND NEW HAVEN.

| Date. 1835. | Observed increase of AR of Moon's first limb. | | Computed Difference of Meridians. | | |
|---|---|---|---|---|---|
| | m. | s. | h. | m. | s. |
| June 7 | 11 | 35.37 | 4 | 51 | 49 |
| " 8 | 12 | 22.56 | | | 64 |
| August 4 | 13 | 11.97 | | | 67 |

EDINBURGH AND NEW HAVEN.

| Date. 1835. | Observed increase of AR of Moon's first limb. | | Computed Difference of Meridians. | | |
|---|---|---|---|---|---|
| | m. | s. | h. | m. | s. |
| June 8 | 11 | 49.96 | 4 | 38 | 69 |
| July 6 | 11 | 53.68 | | | 40 |

The longitude of Cambridge is taken at – 23.54s.; and that of Edinburgh at + 12m. 43.6s.; and the mean of the preceding ten observations gives the longitude of New Haven from Greenwich 4h. 51m. 37.7s. Mean difference, ± 8.4s.

In addition to these observations, on the 9th of August, 1835, two occultations were observed, viz. of $\tau^1$ and $\tau^2$ Aquarii. The immersion of the former occurred at 19h. 13m. 51.5s. sidereal time; that of the latter, at 20h. 57m. 12.5s. I failed to note the emersions with sufficient accuracy to be of any use. To derive any valuable result from these observations, we need to know the true places of the moon and the above stars. From observations made at Greenwich, and published in Vol. IX. of the Memoirs of the Royal Astronomical Society, it appears that 1.11s. should be subtracted from the moon's right ascension, as given in the Nautical Almanac for August 9th. How great may be the error of the moon's declination as given by the tables, I have no satisfactory means of determining. From the observations of Prof. Henderson, however, (Mem. Ast. Soc. Vol. IX. p. 273.) it may be presumed that this error is well nigh insensible. The places of both of the stars are taken as they are given in the Nautical Almanac, and from observations at Greenwich, it appears that the right ascension of the latter at least was very correctly computed. The longitude resulting from the observation of $\tau^1$ Aquarii, is 4h. 52m. 17s., and from $\tau^2$ Aquarii, 4h. 51m. 58s. The first of these differs 39s. from the mean of my former determinations, which would seem to indicate either that the star's place was somewhat different from what it was assumed, or that the observation was a poor one. Finally, the longitude deduced from the eclipse of 1811, according to the computation of Dr. Bowditch, is 4h. 51m. 51s. Bringing then together the results of all the different observations, we have:

June 7, 1835, Greenwich observation, 4h. 51m. 33s. W. long.
“ Cambridge “ 25 “

| | | | | | |
|---|---|---|---|---|---|
| June 8, | 1835, | Greenwich | observation, | 4h. 51m. 45s. | W. long. |
| " | " | Cambridge | " | 40 | " |
| " | " | Edinburgh | " | 53 | " |
| July 6, | " | Greenwich | " | 28 | " |
| " | " | Edinburgh | " | 23 | " |
| July 7, | " | Greenwich | " | 43 | " |
| Aug. 4, | " | Greenwich | " | 44 | " |
| " | " | Cambridge | " | 43 | " |
| Aug. 9, | " | $\tau^1$ Aquarii | " | 77 | " |
| " | " | $\tau^2$ Aquarii | " | 58 | " |
| Sept. 17, | 1811, | Solar eclipse | " | 51 | " |

The mean of these thirteen determinations is 4h. 51m. 43s., and the mean difference is ± 10.5s. If we reject the observation of $\tau^1$ Aquarii, as I think we must, the mean longitude will be 4h. 51m. 40.5s., and the mean difference, ± 8.9s.

I think therefore we may assume for the Observatory of Yale College,

North Latitude, 41° 18′ 28″.
West Longitude, 4h. 51m. 40s.

and I believe these values may be regarded as tolerable approximations to the truth.

## Art. V.—*Notice of Warwickite, a new mineral species;* by Charles Upham Shepard, M. D., Prof. of Chemistry in the Medical College of the State of South Carolina.

The mineral here announced, is one which has for many years been known to the mineralogists of this country as occurring at Warwick, Orange county, N. Y., where it exists in limited quantity along with brucite and yellow idocrase, imbedded in a highly crystalline white dolomitic limestone. It has passed under the name of hypersthene, on account of the very brilliant copper-red reflections afforded by its cleavage planes. The size of the crystals at the locality first discovered, is in general very diminutive,—they for the most part being quite slender, and only a quarter or half an inch in length. A second depository of the mineral however, was observed by Drs. Young and Horton in the vicinity of the first, in which several forms half an inch in diameter have occurred, although the last discovered crystals are wanting in lustre when compared with those first mentioned, and are moreover in a somewhat decomposing condition. They are associated with large crystals of black spinel, which are also dull from partial disintegration, a change apparently induced from the intermixture of serpentine.

A more close attention to the mineral above mentioned, both as relates to its mineralogical and chemical properties, than I have heretofore been able to bestow upon it, has convinced me that it is fully entitled to constitute a new species, which I designate *Warwickite*, from its original locality.

### *Mineralogical Description.*

Primary form. Oblique rhombic prism. M on M = 93° to 94°.

Secondary form. The primary having its obtuse lateral edges truncated, and its acute ones, beveled. The summits rounded.

Cleavage parallel with the longer diagonal perfect. The cleavage planes thus obtained are finely striated vertically, and exhibit very distinct, oblique cross cleavages. Fracture uneven.

Lustre eminently metallic-pearly, of a copper-red color on the perfect cleavage-faces; in other directions, only vitreous in moderate degrees. Color dark hair-brown to iron-gray. Opake, except in very thin fragments, when it is translucent and transmits a reddish-brown light. Streak dark chocolate-brown. Decomposing crystals are nearly iron-black with a faint tinge of purple.

Brittle. Hardness = 5.5 . . . 6.0. Sp. gr. 3.29.

### *Chemical Description.*

When heated on charcoal before the blowpipe, it does not fuse, but simply assumes a lighter shade of color. With borax, it dissolves with effervescence, affording while hot a yellow semi-opake glass, which on cooling changes to a pale green and becomes clear. It renders carbonate of soda opake, at the same time imparting to it a dull yellow tinge. In microcosmic salt, it melts with effervescence, the globule being blood-red while hot, from which it passes through orange-yellow as it cools, and finally becomes reddish-gray and opake. On being pulverized and heated in a glass tube, it emitted moisture and hydro-fluoric acid. The corrosion of the tube became still more distinct on the addition of a few drops of sulphuric acid.

Its powder is feebly attacked by long digestion in dilute hydro-chloric acid. Heated for half an hour with five times its weight of anhydrous carbonate of soda in a platina crucible, a light brown, cohering, porous mass was obtained, which was treated with dilute hydro-chloric acid and digested for some time; a bulky, heavy brown precipitate remained undissolved, which grew paler however towards the end of the digestion. The whole was thrown upon a filter: an abundant milky substance continued to pass the paper so long as water was on the filter, and which (considered along with the blowpipe indications) was regarded as titanic acid. A portion of the hydro-chloric acid liquor (obtained clear by decantation) was treated with a saturated solution of sulphate of potassa without obtaining any precipitate, even after twenty four hours standing. Another portion was examined for silica, lime, magnesia, and alumina, but without detecting either of them. Iron and manganese appeared to be the only bases present.

As the result of the foregoing examination, therefore, I conclude that Warwickite is a fluo-titaniate of iron and manganese; but I must add that my chemical trial was made upon a sample in a decomposing state, though it was still endued with considerable hardness and a faint lustre. As my cabinet at Charleston embraces a large and fresh crystal, I purpose on my return to that city to occupy myself still farther with the elucidation of its chemical properties.

New Haven, May 22d, 1838.

## Art. VI.—*Considerations upon the Nature of the Vegetables that have covered the surface of the Earth, at different epochs of its formation*; read before the Academy of Sciences of Paris, on the 11th September, 1837, by Mons. Adolphe Brongniart.

Translated from the French, and communicated for this Journal, by R. W. Haskins,* of Buffalo, New York.

Curiosity is one of the most distinctive faculties of the human mind; one of those that most clearly mark the distance between man and the brute creation; and for this reason it may be designated one of his most noble faculties, whenever directed to any end really worthy of his being.

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* Mr. Haskins prefers an orthography in some cases peculiar, and retains also certain French idioms.—Eds.

It is this which continually excites us to extend the field of our knowledge, and to fathom the most hidden mysteries of nature, without being able to hope, for the most part, any other reward than the good which will result to all intelligent beings, in proportion as they are able to form ideas more exact upon the nature of the phenomena which surrounded them. These phenomena appear the more difficult of investigation in proportion as, by their nature and position, they are farther removed from our direct observation; and in like manner we are struck with the results to which profound researches have conducted those men who have made these investigations the object of their studies.

The invention of the telescope, by opening to our view what is passing in the elongated regions of space; and of the microscope, by revealing to us the existence of numberless beings so minute as, but for this instrument, would forever have escaped our observation, have made, upon the human imagination, the most vivid impression.

The sciences have made such rapid advances, within late years, that no one can reasonably expect to open new views and to disclose new truths equally exciting to human curiosity as those disclosed by the telescope and the microscope; but still, the study of the soil upon which we daily tread, has become, within the last half-century, in the hands of Werner, of Cuvier, and the crowd of learned and able men who have assiduously followed these illustrious pioneers, one of the sciences the most fruitful in results, not only of high interest to the professionally learned, but well calculated vividly to interest the imagination of all persons who love to reflect upon the great phenomena of nature.

In investigating the layers which compose the superficial strata of the earth, their order of super-position, their nature, and the animal and vegetable remains which they contain, Geology traces for us the history of the earth during the long periods of time that have preceded its present condition; it makes known to us the beings which have successively inhabited its surface, the revolutions that have conduced to their destruction, and those which have given birth to the mineral layers the earth contains, and the modifications to which this surface itself has been subject by reason of these revolutions; it discloses to us, in short, that all these phenomena, which have necessarily required so many centuries for their accomplishment, were prior, in point of time, to the creation of man. It conducts us alike to appreciate events, and to re-construct beings which have preceded, many thousand years, not only the most ancient historical traditions, but also the very existence of our race.

This prolonged history of the formation of the superficial strata of the earth, is constituted, like the history of nations, of periods of repose, or of tranquility sufficiently great, at least, for the waters and the dry land of the surface to become peopled by a variety of inhabitants; and of periods of revolution, during which resistless forces have agitated this surface, elevating mountains, submerging lands previously dry, and causing ancient beds of oceans to issue from the bosom of the deep; in short, pouring over pre-existing rocks the materials for new layers which, enveloping the ruins of living beings, destroyed by these violent convulsions, have thus preserved their remains as precious monuments which now reveal to us, after so many thousand years, the nature of the ancient inhabitants of our globe, and the order in which the several races of beings have succeeded each other.

The study of the periods of these revolutions, and of those of repose, are alike of the most vivid interest: but the first are entirely the province of the geologist; while the second, on the contrary, necessarily require the light of the zoölogist or the botanist; for these alone are able, by an exact comparison of the fossil remains of former beings with the corresponding parts of such as are now existent, to determine the relations which exist between the inhabitants of the globe, at various and distant epochs. It was thus Cuvier, in his admirable researches upon fossil bones, basing his investigations upon the positive data which comparative anatomy furnishes, was enabled to re-construct the skeletons of the greater part of the animals of which the remains had then been discovered, and also to determine, with the greatest probability, their exteriour forms, and their analogy to those animals with which we are now acquainted.

Botany, notwithstanding it has long furnished fewer documents upon the ancient state of the globe, ought, nevertheless, to be equally laid under contribution, by the geologist; and it is even able to cast more light than zoölogy upon the state of the terrestrial surface, during the most ancient periods of its formation.

Indeed, at that epoch when life first began to be manifested upon our globe, the animals were all confined to the interiour of the waters, and even these presented but diminished specimens of their kinds; while a powerful vegetation, forming vast forests, covered, at that early period, all such parts of the earth as were not submerged by the sea; and each succeeding period of repose has had its own peculiar vegetation, more or less varied, and in greater or less abundance, according to the circumstances which influenced the development of the beings that composed it, and perhaps, also, in proportion to the duration of these periods; but almost always entirely different from those of either the preceding or succeeding epochs.

Of the different associations of vegetables which have successively inhabited our globe, there are none which so pointedly merit our attention as those which seem to have been first developed upon its surface; which appear, during a long space of time, to have covered with dense forests all those parts of the earth that rose above the general level of the waters, and of which the remains of successive growths, heaped one upon another, have formed our layers of coal, so deep, extensive and numerous; and in this form the remains of these primeval forests, which have preceded, by so many centuries, the existence of man, and which now supply us with fuel, in place of our more modern forests, of which the great increase of the human family is causing a rapidly augmented destruction, have become one of the principal sources of the prosperity of nations.

None can doubt that coal owes its origin to accumulated masses of vegetables, changed and modified, as probably the layers of peat in our marshes would be, if they had been overlaid by thick coverings of mineral substances, compressed under the weight of these, and subsequently exposed to an elevated temperature. If farther confirmation of this origin were necessary, it is found in the almost ligneous structure which coal sometimes presents, and in the numerous remains of plants contained in the rocks which accompany it.(1)

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(1) The most complete and valuable collection of plates of impressions of these coal plants which is generally accessible, in this country, will be found in this Journal, Vol. xxix, No. 2. This volume contains Dr. Hildreth's valuable paper upon the coal deposites of the valley of the Ohio, which he has accompanied with some thirty pages of excellent drawings of fossil remains and impressions, mostly vegetable, found in the accompanying rocks.—*Translator.*

But the study of the impressions of stems, leaves, and even fruit, which are in general contained, in so great quantities, in these rocks, proves not only the vegetable origin of this substance, but even enables us to determine the nature of the vegetables of which it has been formed, and which, consequently, at the period of such formation, occupied the surface of the earth.

Among these vegetable imprints, the most frequent are those produced by the leaves of the Ferns; yet these Ferns of the primitive world are not those which now grow in our climates; for Europe, at this time, does not produce more than from thirty to forty species, while the same regions then nourished more than two hundred, all much more analogous to those now found between the tropicks than to those of the temperate climates.

In addition to the leaves of Ferns, the same earths contain trunks, the dimensions of which render them comparable to the most gigantick trees of our forests, while their form is wholly dissimilar; and indeed all the ancient naturalists, struck with this dissimilarity, and yet desiring to find analogous productions still existent, referred them to arborescent vegetables, then imperfectly known, as the Bamboos, Palms, and the great Cactus, sometimes designated *Torch-thistle.* But a more attentive comparison of these products of the equinoctial regions with those trunks, the growth of the ancient world, suffices to dissipate all relations, which are founded only on some resemblances in the general aspect, that have been attempted to be established between them; and a more profound examination, either of these trunks or of the leaves which accompany them, readily shows that the vegetables which formed these primitive forests are not identical with any trees still found flourishing upon the earth.

The arborescent Ferns which, by the elegance and magnitude of their exteriour, now form one of the principal ornaments of the equatorial regions, are the only arborescent vegetables which are recognized, even in small number, among the trees of this antique vegetation.

As to the other fossil stems, remains of these primitive forests of the ancient world, it is among the most humble vegetables of our epoch that we must seek their analogues.

For instance, the Calamites, which attained from four to five mètres (a little more than 13 to 16 feet) of height, and from one to two décimètres (not quite four to eight inches) of diameter, have almost a complete resemblance, in all the points of their organization, with the Equiseta (Horsetails) which grow so abundantly in the marshy situations of our climates, and of which the stems, hardly as large as the finger, rarely surpass one mètre (about 39⅜ inches) in height. The Calamites, then, were arborescent Equiseta, a form under which these plants have wholly disappeared from the surface of the earth.

The Lepidodendrons, of which the numerous species appear to have mainly constituted the forests of this ancient epoch, and which have probably contributed more than all other vegetables to the formation of coal, differ very little from our Lycopodiæ. We recognize in their trunks essentially the same structure, the same mode of ramification; and in short we see inserted upon their branches leaves and fruits analogous to those of these vegetables. But, while the Lycopodiæ of the present day are small plants, most frequently creeping, and similar to the great mosses, attaining very rarely one mètre (about 39⅜ inches) in height, and covered with very diminutive leaves, the Lepidodendrons, preserving the same form and aspect, elevated themselves to twenty or twenty-five mètres (a little more than 65 to 82 feet,) having, at their base, near one mètre (about 39⅜ inches) of diameter, with leaves which sometimes attained to half a mètre (over 19½ inches) in length. These were, consequently, arborescent Lycopodiæ, comparable, by their stature, to the largest Firs, of which they enjoyed the rank, in this primitive world; forming, as these now do, immense forests, in the shade of which were developed the Ferns, so numerous at that period.

How different this powerful vegetation from that which now clothes, in ever-varying tints, the surface of the earth! Magnitude, strength, and activity of growth, constituted its essential characteristicks; the smallest plants of our epoch were then represented by gigantick forms; and yet, what simplicity of organization, and what uniformity in the midst of a vegetation so enormous!

At the present day, even in those regions where nature has suffered no change at the hand of man, the eye reposes with delight upon trees which are immediately distinguishable by the diversity of their form, and the tints of their foliage; and which often support flowers or fruits of the most dissimilar colours. This variety of aspect is still more strongly illustrated by a contemplation of the diversified shrubs and plants which fringe the borders of our forests, or adorn our meadows, and of which the flowers exhibit to us almost all the tints of the prism. Finally, there result from this diversity of structure, among these plants, many varieties suited to the nourishment of man or of animals; and indeed such as are even indispensable to their existence.

The variety in the organization and aspect of the vegetables which at present cover our globe is indicated by the number of natural groups into which they are capable of being divided. These groups or natural families amount to more than two hundred and fifty, of which about two hundred belong to the class of the Dicotyledons, (which consequently present the greatest variety of structure,) and thirty to that of the Monocotyledons. Now the first of these classes, that is, the two hundred families which they contain, are completely wanting in our primitive flora, and seldom can we there recognize any indications of the Monocotyledons.

The class which constituted, almost alone, the vegetation of this primitive world is that of the vascular Cryptogamia, which at present comprehends no more than five families; almost all of which had parallels in the ancient world; such are the Ferns, Equiseta and Lycopodiæ. These families constitute, thus to speak, the first degree of ligneous vegetation: they present, like the arborescent Dicotyledons or Monocotyledons, trunks more or less developed, of a solid texture, although more simple than those of these trees, and garnished with numerous leaves; but they are deprived of those reproducing organs which constitute the flowers, and they present, in place of fruit, organs much less complicated.

These plants, so simple, so little varied in their organization, and which, by their number and dimensions, rise not above a very inferiour rank, in our present vegetation, constituted, in the dawn of the creation of organized beings, almost the entire vegetable kingdom, and formed forests so immense that we find not their analogy in modern times. The rigidity of the leaves of these vegetables, the absence of fleshy fruits and farinaceous seeds, would have rendered them very unfit to have served as aliment to animals: but terrestrial animals, at the time of their growth, had not yet existence; the seas alone offered numerous inhabitants; and the vegetable kingdom, at that period, maintained undivided sway over all the undeluged portions of the earth; upon which it seems to have been called to play another part, in the economy of Nature.

We cannot doubt, in truth, that the immense mass of carbon accumulated in the bosom of the earth, in a state of coal, and which is the product of the destruction of those vegetables which grew at that ancient epoch, upon the surface of the globe, has been imbibed, by those vegetables, in the carbonick acid of the atmosphere—the only form under which carbon, not derived from the destruction of preëxisting, organized beings, can be absorbed by plants.

Now, a proportion, even very feeble, of carbonick acid, in the atmosphere, is generally an obstacle to the existence of animals, and particularly of the most perfect classes of them, as mammifers, and birds; while, on the contrary, this proportion is highly favourable to the growth of vegetables: and if we admit that there existed a proportion very much greater of this gas in the primitive atmosphere of our globe than the present atmosphere is found to contain, we may consider this one of the principal causes of the powerful vegetation of these ancient epochs.

This collection of vegetables, so simple, so uniform, and which would consequently have been so little fitted to furnish suitable aliment for animals of diversified structure, such as those existing at the present day, in purifying the atmosphere of the carbonick acid which it then contained in excess, would have prepared the conditions necessary to a creation more varied: and if we still wish to indulge that sentiment of pride which has caused man to assume that all in nature has been created exclusively for him, we may suppose this primitive, vegetable creation, which preceded, by so many centuries, the appearance of man upon the earth, was, in the economy of nature, designed to prepare the atmospherick conditions necessary to his existence, and at the same time to accumulate those immense masses of combustibles which his industry was in future time to apply to his necessities.

But, independently of this difference in the nature of the atmosphere, which the formation of these vast depots of fossil carbon renders extremely probable, may not the nature of the vegetables themselves, that have produced them, furnish some data upon the other physical conditions to which the surface of the earth was subjected during this period? The operations of nature now going on in different regions of the globe, may throw some light upon this question.

The study of the geographical distribution of those plants appertaining to the same families which alone composed the vegetation of the coal period, may, indeed, indicate to us the climacterick conditions and consequently the physical causes which favoured the increase of stature as well as the great frequency of these vegetables; and we may conclude from these, with much probability, that the same causes determined their preponderance at that epoch.

We see, for example, that the Ferns, Equiseta, and Lycopodiæ attain a more lofty stature in proportion as their geographical position approaches the equator. Thus it is only in the hottest regions of the globe that we find those arborescent Ferns which combine with the towering and majestick mien of the Palms, the elegant foliage of the ordinary Ferns, and of which we have indicated the existence in the coal formations. In these same regions the Equiseta and Lycopodiæ attain to a stature double or triple that which the largest of these species present in temperate climates. A second condition appears to have a still more marked influence upon their preponderance, in reference to the vegetables of other families, namely, humidity and uniformity of climate; conditions which are united in the highest perfection, in the small islands situated far distant from continents.

In such islands, indeed, the extent of the surrounding oceans fixes a temperature with but slight variations, and coupled with perpetual humidity; circumstances which appear to favour, in a remarkable manner, the development and the variety of specifick forms among the Ferns and the analogous plants; while, on the contrary, under the influence of the same conditions, the phenogamous plants are little varied, and are far less numerous. From these causes it results, that while on the extensive continents of the earth the vascular Cryptogamick plants, such as the Ferns, Lycopodiæ, Equiseta, &c. often form scarcely one fiftieth of the total number of vegetables, yet in the small islands of the equatorial regions, these same plants constitute almost half, and in some cases, even two thirds of all the vegetables which inhabit them.

The archipelagos, situated between the tropicks, such as the islands of the great Pacifick ocean, or the Antilles, are, then, the points of the globe which at the present time present vegetation the most analogous to that which existed upon the earth when the vegetable kindom commenced, for the first time, to develop itself thereon.

Detailed examination of the vegetables which accompany the coal cannot fail, therefore, to induce the inference that at this remote epoch the surface of the earth, in the countries where are found those vast depots of fossil carbon with which we are most familiar, namely, in Europe and North America, offered the same climacterick conditions which now exist in the archipelagos of the equinoctial regions; and probably a geographical configuration little different.

When we consider the number and thickness of the layers which constitute most of the coal formations, and examine the changes that, from first to last, have taken place in the specifick forms of those vegetables of which they have been constituted, we cannot fail to see that this stupendous primitive vegetation, during a long interval, must have covered with its dense forests all parts of the globe which were at that period elevated above the sea; for all these present themselves with the same characteristicks in Europe and America; and equinoctial Asia, as well as New Holland, seem therefore to have participated, in this general uniformity of the structure of vegetables.

Nevertheless, this primitive vegetable existence promptly disappeared, to give place to a new creation, composed of beings of an organization less extraordinary than the preceding, but almost equally different from such as flourish at the present day.

To what cause can we attribute the destruction of all the plants which characterize this remarkable vegetation?

Is it due to some violent revolution of the globe? Did it arise from a gradual change of the physical conditions necessary to their existence; a change in part arising from the presence of these vegetables themselves? These questions cannot be resolved in the present state of our knowledge upon the subject.

Certain it is, however, that the deposition of the last layers of the coal formation was followed by the destruction of all the species which constituted this primitive vegetation, and particularly of those gigantick trees of peculiar structure, as the Lycopodiaceæ, the Ferns and the Equiseta of gigantick growth; which was an essential characteristick of this primitive creation.(2)

After the destruction of this primitive vegetation, the vegetable kingdom appears for a long period not to have attained the same degree of development. Indeed, in the numerous layers of secondary earths which succeed the coal formations we scarcely ever find those masses of vegetable imprints, a species of natural herbariums, which, in these ancient depots of carbon attest to us the simultaneous existence of a prodigious number of plants. Scarcely in any part of these formations do we meet with thick layers of fossil combustibles; and never are such layers often repeated, or found of such great extent as in the coal deposits. Either the vegetable kingdom at this period occupied more circumscribed portions of the surface of the earth, or its scattered individuals covered but incompletely a soil of little fertility, and of which the revolutions of the globe had not permitted them to become tranquil possessors; or, finally, the condition of the surface of the earth was not favourable to the preservation of the vegetables which then inhabited it.

Yet that long period which separated the coal from the tertiary formations, a period that was the theatre of so many physical revolutions of the globe, and which witnessed the appearance, in the waters of the deep, of gigantick reptiles, types of the fantastical organizations in which we may suppose we often recognize those monsters born of the imaginations of the poets of antiquity; this period, I say, is remarkable in the history of the vegetable kingdom, by the preponderance of two families which are lost, so to speak, in the midst of the immense variety of vegetables with which the surface of the earth is covered, at the present day, but which then predominated over all the others, by their number and their magnitude. These are the *Coniferæ*, of which the Fir, Pine, Yew and Cypress furnish well known examples; and the *Cycadeæ*, vegetables wholly exotick, less numerous at the present day than at this ancient period, and which joined to the leaves and mien of the Palms, the essential structure of the

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(2) We find, it is true, in some parts of the secondary formations, a small number of arborescent Ferns and of the gigantick Equiseta, but yet of a stature much less considerable than those of the coal formations; nor do we discover, there, any trace of the arborescent Lycopodiaceæ analogous to the Lepidodendrons.—*Author's note.*

Coniferæ. The existence of these two families, during this period, is of high importance as signalizing an intimate relation between them, by their organization; and they form the intermediate link between the vascular Cryptogamia, which composed, almost alone, the primitive vegetation of the coal period, and the phanerogamick Dicotyledons, strictly speaking, which constituted a majority of the vegetable kingdom, during the tertiary period.

Thus, to the vascular Cryptogamia, the first degree of ligneous vegetation, succeeded the Coniferæ and the Cycadeæ, which held a rank more elevated in the vegetable scale; and to these last succeeded the dicotyledonous plants, which occupy the summit of that scale.

In the vegetable kingdom, as in the animal, there has been, then, a gradual improvement in the organization of the beings which have successively existed upon our earth, from the first which appeared upon its surface even to those that inhabit it at the present day.

The tertiary period, during which were deposited those earths that now form the soil of the principal capitals of Europe, as London, Paris, and Vienna, witnessed transformations, in the organick world, greater than any of those which had taken place since the destruction of the primitive vegetation.

In the animal kingdom: the creation of mammifers,(3) a class which all naturalists concur in placing at the summit of the animal scale, and by which nature seems to have preluded the creation of man; in the vegetable kingdom, the creation of the Dicotyledons, a grand division which, by unanimous consent, botanists have always placed at the head of this kingdom, and which, by the variety of its forms and organization, by the magnitude of its leaves and the beauty of its flowers and its fruits, must, of necessity, have imprinted upon vegetation an aspect very different from that which it had offered through all previous periods.

This class of Dicotyledons, of which we are scarcely able to cite any indications at the close of the secondary, presented itself, all at once, during the tertiary period, with preponderating influence. It then, as at the present day, held dominion over other classes of the vegetable kingdom, both in reference to the number and variety of the species, as well as the magnitude of the individuals. Thus the assemblage of vegetables which inhabited our climates during the deposition of the tertiary formation, which enveloped their ruins in its sedimentary layers, were intimately allied to the mass of our present vegetation, and more particularly to the flora of the temperate regions of Europe and America. The soil of these countries was covered then, as at present, with Pines, Firs, Culms, Poplars, Birches, Elms, Walnuts, Maples, and other trees almost identical with those which still flourish in our climates.

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(3) In placing the first appearance of mammifers at the epoch of the tertiary formation, I do not include the fact, unequalled elsewhere, of the fossil mammifers of Stonesfield; a case which forms an exception to all former experience, and which cannot be detailed in so limited an essay.—*Author's note.*

For drawings and brief descriptions of these fossils, which occurred in *oolite*, see Lyell's Geology, American edition, Vol. I. pp. 154–5.—*Translator.*

And yet, not only do we not recognize any indications of those singular vegetables which characterized the primitive forests of the coal period, but we rarely encounter, there, even fragments of plants analogous to those which now vegetate between the tropicks.

We do not, however, necessarily infer that the same vegetable forms have been perpetuated from this epoch, still very ancient, (since it preceded the existence of man,) to the present day. No: very sensible differences almost always distinguish these inhabitants of our globe, very recent, geologically, but exceedingly ancient, chronologically, from our cotemporaneous vegetables to which they seem most nearly allied; and the existence in these same earths, in the north of France, of Palms, very different from those which still vegetate upon the borders of the Mediterranean, and of a small number of other plants which appertain to families now limited to the more torrid regions, seem to indicate that at this epoch central Europe enjoyed a temperature more elevated than at present; which, besides, accords very well with what we may deduce from the presence, in the same formations, and the same countries, of Elephants, Rhinoceroses and Hippopotami, animals which are now rarely found to range beyond the tropicks.

What an astonishing contrast between the aspect of nature during modern geological periods, and that which she offered when the primitive vegetation covered the surface of the globe!

Indeed, at the periods in question of the geological history of the world, the earth had already assumed, in great part, at least, the form which it presents at the present day; continents very extended, and mountains greatly elevated, fixed and determined varied climates, and thus favoured diversity of beings. In this way, in countries of little extent, the vegetable kingdom offered us plants equally as diversified, one from another, as those found growing at the present day.

To the Coniferæ, with their narrow durable leaves of sombre green, were joined Birches, Poplars, Walnuts, and Maples, with broad leaves of a more lively tint; and in the shade of these trees, on the borders of waters or upon their surface flourished herbaceous plants, analogous to those which at present embellish our fields by the diversity of their forms and colours, and the variety of which renders them suitable to satisfy the different tastes of an infinity of animals, of all classes.

The forests of the ancient world, like those of our epoch, served, indeed, as a refuge for a vast number of animals, more or less analogous to those which still inhabit our globe. Thus Elephants, Rhinoceroses, Wild Boars, Bears, Lions, and Stags of all forms and of all statures, have successively inhabited them; while birds, reptiles, and numerous insects, complete this map of nature, as she presented herself, upon such parts of the earth as were elevated above the level of the oceans; the whole forming a scene equally beautiful and equally varied as that which is still witnessed upon the emerged portions of our globe.

On the contrary, at the dawn of the creation of organized beings, the terrestrial surface, divided, without doubt, into an infinity of islands, low, and with a climate almost uniform, was, it is true, covered with immense vegetables; but these trees, differing little from each other in their aspect, and the tint of their foliage; deprived of flowers and of those fruits with brilliant colours which so highly adorn many of our large trees, must have imprinted, upon that vegetation, a monotony not interrupted even by those small herbaceous plants that, by the elegance of their flowers, constitute the ornament of our groves.

Add to this that neither mammifer, or bird, nor any animal, in short, was present to enliven these dense forests, and we may be able to form a very just idea of this primitive nature; sombre, cheerless and silent, but at the same time so imposing by its grandeur, and by the space which it has been called to fill in the history of the globe.

Such, gentlemen, is a rude outline of the great revolutions of terrestrial vegetation, as the researches made upon this subject, within the last thirty years, have enabled us to trace them. Each day will doubtless add new traits to these details; but recent discoveries, by confirming the results at which we had previously arrived, seem to assure us that this general delineation will not experience great changes when, thanks to the materials that are being collected on all sides for this object, we shall be enabled to transform this rough draught into a picture more finished and complete.

## Art. VII.—*Notice of a second locality of Topaz in Connecticut, and of the Phenakite in Massachusetts;* by Charles Upham Shepard, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

Among specimens which I obtained at the China-stone quarry in Middletown two years since, I find one to be invested with above fifty crystals of Topaz. They measure from ⅛ to ⅓ of an inch in length, are very slender, and perfectly transparent, being attached by a lateral plane to crystals of albite. Owing to their minuteness, it is difficult to distinguish, except in one or two instances, the leading planes of the forms. In one crystal, I detect the truncation of the obtuse lateral edges, the truncation and bevelment of the acute lateral edges, and the replacement of the acute solid angles by faces inclining to the last mentioned truncating planes under angles of about 153°. In addition to which modifications of the primary form, there are also visible the replacement of the terminal edges by two planes and that of the edges intermediate between these and the angular truncations, by single planes. The future exploration of the quarry will probably lead to the discovery of more perfect crystals of the present species than have hitherto been found in the United States.

The Phenakite, it will be recollected, was first recognized as a distinct species by Nordenskiold, in 1833,—the specimens having been derived from the vicinity of Katherinenberg, upon the eastern slope of the Ural mountains, where it occurs in granitic rock along with emerald and mica. The resemblance of the mineral is said to be very striking to quartz; like that species, it being derived from the rhomboid, in addition to which also, it has the lustre, transparency, and color of quartz. In chemical composition however, it is more nearly related to the beryl, being a bisilicate of glucina.

My first knowledge of the American mineral which I take to be Phenakite, was acquired about fourteen years ago, during a visit to the tourmaline locality in Goshen, (on the farm of Mr. Weeks,) in company with Mr. Nuttall and the late Dr. Hunt of Northampton. My first impression was, that it belonged to iolite,* an opinion I afterwards changed in favor of the species beryl,† under which name, I believe, it has generally passed in cabinets ever since.‡ Prof. Hitchcock, in his Report on the Geological survey of Massachusetts, (p. 506, 1st edit.,) undoubtedly refers to the same substance, when he says, "Beryls are frequently met with in our granite, though in general they are not very delicate. Perhaps the most so is a limpid, large beryl, occurring in Goshen, along with spodumene, &c. It is rare to find it distinctly crystallized, and it is full of fissures. Sometimes it is of a light rose color. (Nos. 1525 to 1528.)" Nor can there be the slightest question that the "rose-colored emerald" alluded to by Col. Gibbs,§ as furnished him from Goshen, pertains to the species under consideration.

It occurs in considerable plenty, distributed through the granite in small crystalline masses, from the size of a pea to a hazel-nut, generally oval in form, and rarely in short hexagonal prisms, some of which present one face or more of the primary rhomboid, in the absence of their alternate angles. Other masses are rounded, and offer occasionally a few roughened faces, which probably pertain to the primary or to a secondary rhomboid. The prevailing color is a pale bluish white; though sometimes a faint rose-colored tinge is observable, especially in the well-formed hexagonal prisms. Lustre vitreous; transparent to translucent only on the edges. When perfectly transparent, it is a very handsome gem, much resembling the euclase, and like that mineral, is filled with fissures, and very fragile, though wanting in its brilliant cleavage. Hardness = 7.5, being barely adequate to scratch quartz.

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* Boston Journal, vol. 13, p. 395. † Idem, p. 607.

‡ It should be remarked moreover, that it was referred by some collectors for a time, to topaz.

§ Vol. 1, p. 351 of this Journal.

It is scratched by beryl. Sp. gr.=2.80 . . . 2.97—varying in different specimens, chiefly on account of slight intermixtures of grains of quartz, or albite.

Before the blowpipe, in very thin fragments, it phosphoresces, turns white, and fuses with difficulty into a milk white, semi-blebby globule. With borax, it forms a transparent glass; and with the microcosmic salt, fuses into an opaque, white globule. Thirty-three centigrammes, in the condition of an impalpable powder, after heating for fifteen minutes in a platina crucible, lost 0.75 centigramme. It was then mingled with three times its weight of anhydrous carbonate of soda, and ignited for one hour. The mixture shrunk into a somewhat firm, white, porous mass. It was crushed in a mortar and treated with hydrochloric acid. A perfect solution was thereby obtained, with the exception of certain flocculi of silica. The silica was separated and ignited: it weighed 18 centigrammes, or 55.81 p. c. The solution from which the silica had been separated, was precipitated with ammonia. This clear supernatant fluid was tested for lime and magnesia without detecting either of those earths. The precipitate, while moist, was largely treated with a solution of carbonate of ammonia, by which it was almost wholly taken up after a period 18 hours,—frequent agitation having been employed to favor the solution. The undissolved residuum, which was trifling in quantity, compared with the portion taken up, was dissolved in hydrochloric acid, and to it were added sulphuric acid and potassa. No crystals of alum were formed; from whence it was concluded that the undissolved matter was chiefly glucina. Had not other engagements intervened, it would have been easy to have completed the analysis on the portion of mineral first pulverized; but sufficient information has perhaps been gained, to afford a probable corroboration of the opinion originally made up from its natural properties.

I suspect the existence of Phenakite also at Paris, in Maine, where I obtained many years ago, small, white, hexagonal prisms in granite, associated with tourmaline; and which I then supposed to be beryl. I regret that my collection in this city does not furnish me with the means of putting this conjecture to the test.

New Haven, May 29, 1838.

## ART. VIII.—*Chemical Analysis of Meteoric Iron, from Claiborne, Clarke Co., Alabama;* by CHARLES T. JACKSON.

*Aug.* 5, 1834.—Mr. F. ALGER handed me this remarkable mineral, which he had received from Mr. Hubbard, who had obtained the specimen during his travels in Alabama, and thought, from the bright streaks in it, that it might be an ore of silver.

On examining this substance, it soon appeared that it was different from any metallic ore of terrestrial origin, and that it is a very peculiar and remarkable meteorite.

Having surmised its probable origin, I was desirous of seeing the gentleman who brought it from Alabama, and at the request of Mr. Alger, Mr. Hubbard called upon me and gave me the following particulars as to its locality.

He found the specimen on the surface of the earth, near Lime Creek, in Claiborne, Alabama. The soil at that place is composed of red marl, or clay, and the rocks in place are sandstones, mostly of a gray color. The mass from which my specimen was broken, was of an irregular triangular shape, rounded at the corners, and was 10 inches long by 5 or 6 inches in thickness. It was extremely heavy, insomuch that he could not conveniently carry with him the whole mass, and therefore employed a negro to break it with a sledge-hammer; which operation proving too difficult for him, Mr. Hubbard took the sledge himself, and with the cutting edge, by many hard blows, he ultimately succeeded in detaching the portion in my possession. It is much to be regretted that he did not bring with him the whole mass, and I desired him to send for the remainder, but have not yet heard from him. He is of opinion, that there are many other similar masses near the spot where this was found; but it is not probable that they abound to the extent imagined. I beg leave, however, to call the attention of travellers to the locality mentioned, where the remainder of the specimen still exists neglected.

*Description of the Specimen.*—It is of an irregular form, rounded upon all the sides excepting on that where it was fractured, which presents a rough hackly surface, with projecting, bright, silvery streaks, and deep greenish and brown eroded surfaces, from which an exudation of green liquid takes place, on exposing the specimen to moist air.

The rounded surface is coated with a thin layer of the *sub-chloride of iron*, which being removed, the mass is found to consist of *metallic matter*, resembling wrought iron, when the specimen is filed bright. On attempting to break off a fragment, the mass was found to be extremely tough and malleable, so as to require the aid of a file and cutting-chisel.

Sp. gr. on three separate fragments from different parts of the mass, 5.750, 6.400 and 6.500. The whole mass weighs 28 ounces avoirdupois.

Having washed the specimen in distilled water several times, I filed one side of it bright, and left it exposed to the air in my cabinet. In a few days, numerous grass-green drops of liquid began to collect on its surface, and became externally coated with a thin brown film. This liquid had a slight alkaline astringent taste, but gave no alkaline reaction with tumeric paper or Brazil wood solution. A few drops collected in a test tube and diluted with water, gave an *abundant thick curdy white precipitate*, with a solution of *nitrate of silver*, showing the presence of chlorine in combination. *Ferro-cyanate of potash* gave a *blue precipitate*, indicative of iron, and *ammonia* gave a precipitate of the *hydrated peroxide of iron*. Muriate of ammonia having been added to a little more of the exudation, the peroxide of iron was precipitated by ammonia, and the remaining liquid was of a pale blue color, indicative of nickel, and on addition of pure potash, hydrate of nickel formed in a bulky green precipitate.

Thus the green drops in question were proved to be composed of the hydro-chlorates of nickel and iron, and they doubtless form from the action of the moisture of the atmosphere upon the metallic chlorides contained in the meteorite.

*Analysis of the mass.*—Several fragments of the specimen having been cut off by means of a steel chisel and hammer, their specific gravities were ascertained, and they were then subjected to analysis.

Specimen 1. A fragment weighing 25 grains, sp. gr. = 5.750, being placed in a green glass flask, and pure nitric acid poured upon it, no action took place until heat was applied, when a violent effervescence, with extrication of nitrous acid fumes, began, and the solution was rapidly and entirely effected. The solution was then treated with a sufficient quantity of the solution of muriate of ammonia, to prevent the precipitation of the nickel, and then the peroxide of iron was thrown down by means of liquid ammonia. When the precipitate had subsided, the whole was thrown on a filter, and the peroxide of iron was thoroughly washed, dried, ignited in platina capsule, and weighed = 23.5 grs. peroxide of iron = 16.296 grs. metallic iron.

The solution, which had passed the filter, was of a clear blue color, with a slight amethystine tint, indicative of nickel. This solution and the mingled washings were evaporated in a glass vessel to a small bulk, and then treated, while warm, with a hot solution of pure potash, when a dense bulky green precipitate of the hydrate of nickel was thrown down, which being collected on a filter, washed, thoroughly dried and ignited in a platina crucible, weighed 8.8 grains = oxide of nickel = 6.927 grains metallic nickel.

Analysis—2d specimen. A fragment of the meteorite, weighing 50 grains, was found to have a sp. gr. = 6.500.

It was placed in a green glass flask,—perfectly pure nitric acid was poured upon it, and heat was gradually applied until the solution was completed. It was then diluted with pure distilled water, and a solution of nitrate of silver was added, when an abundant curdy white precipitate of chloride of silver took place. When the operation was complete, I filtered the solution, collected the washed chloride of silver, and dried and fused it in a small porcelain capsule. It weighed = 3 grains = chloride of silver = 0.74 gr. chlorine, or 0.76 hydro-chloric acid.

The solution was then cleared of nitrate of silver, by means of hydro-chloric acid, and filtered. Then muriate of ammonia being added, the peroxide of iron was precipitated by pure ammonia, and after washing, drying, and ignition, weighed = 48 grains = 33.28 grs. metallic iron.

The oxide of nickel was precipitated by means of a solution of pure potash, and when collected, washed, dried, and ignited, weighed 15.8 grains oxide of nickel = 31.6 per cent. = 24.708 per cent. metallic nickel. After the separation of the metallic oxides, the solution was treated by means of a solution of acetate of barytes, and a white precipitate of sulphate of barytes was formed, which weighed, after washing and drying, = 27 grains = 2 grs. sulphur.

The presence of chrome and of manganese having been indicated, I took a separate portion of the meteorite, weighing 10 grains, dissolved it in hydro-chloric acid, adding sufficient tartaric acid to retain the oxides in solution, neutralized the acid by ammonia, and precipitated the iron and nickel, by means of a current of hydro-sulphuric acid gas; after filtration, I evaporated the solution to dryness and burned off the tartaric acid in a small platina capsule under the muffle, when a small quantity of chromic acid was obtained, which was recognized by its characters before the blowpipe; its amount was estimated at 3 per cent. The manganese is also estimated.

From the above analyses, it will appear that specimen 1st of the meteoric iron, having a sp. gr. of 5.750, contains in 25 grains,

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|---|---|
| Metallic iron, - - | 16.296=65.184 per cent. |
| " nickel, - - | 6.927=27.708 " " |

And in specimen 2nd, having a sp. gr. of 6.500 in 50 grains we have

| | | or in 100 grains. |
|---|---|---|
| Metallic iron, - - - | 33.280 | 66.560 |
| " nickel, - - - | 12.354 | 24.708 |
| " chrome and manganese, | 1.625 | 3.240 |
| " sulphur, - - - | 2.000 | 4.000 |
| " chlorine, - - - | .740 | 1.480 |
| | 49.999 | 99.988 |

It will be remarked, that this meteorite contains an unusual proportion of nickel, and that the occurrence of chlorine, in matter of celestial origin, is here noticed for the first time.

I beg leave therefore, to invite chemists to a careful review of meteorites, since the occurrence of chlorine may have been overlooked in former analyses.

Its occurrence in meteoric matters, is a fact of great importance, in accounting for their chemical phenomena, while passing through our atmosphere.

It must also be remembered, that chloride of iron is readily volatilized at a high temperature, *and that it is abundantly exhaled from the craters of volcanoes*, in various parts of our planet.

Nickel, however, has not to my knowledge been discovered amid volcanic sublimations, but it may be worth while to call the attention of chemists to the subject, that it may be sought for in volcanic craters.

I am however far from believing that we shall be able to prove that all meteorites originate from volcanic sublimations, for there are very evident reasons for believing that our planet, statedly in its course, passes amid numerous detached masses of matter or asteroids, which regularly meet the earth in its orbit on the 13th of November; at least such are the views of Prof. Olmsted, of Arago and Gay Lussac, whose opinions appear to be supported by the facts which they have collected.

Allowing that meteoric matters are projected from cometary masses, which statedly cross the earth's orbit, coming within the limits of its attraction, and are subjected to the oxidizing influence of the atmosphere, so as to take fire and fall in burning masses upon the surface of the earth; we can more readily account for the phenomena exhibited in their splendid coruscations, when we know that the meteors contain ingredients possessing remarkable decomposing powers, if brought into contact with water or aqueous vapor, and such are the effects of the chlorides of iron and nickel.

In several instances on record, we find the meteor first discovering itself, bursting into fire, from the midst of a dark cloud, and throwing off brilliant coruscations of light, and ejecting ignited masses which fall to the earth; while the globe of fire, from which they were thrown off, traverses the heavens, and gradually becomes extinct. May not therefore the moisture of the atmosphere have first kindled the meteor in its passage through the humid clouds? I do not know whether they are generally too distant from the earth to come in contact with clouds, but from the rapidity of these apparent meteors they cannot be very distant, at the moment of their conflagration. Should chlorine prove to be a common or constant ingredient, I suppose, that we should have a ready solution of the phenomena involved in the problem.

With respect to the specimen, which forms the subject of the present communication, if we consider its chemical composition, we are forced to regard it of celestial origin; for we have no similar natural alloy in this world, and it contains elements, which are generally found in meteoric matters, besides the new ingredient which I have discovered as one of its components. It is clearly impossible that this mass should have been factitious; for in all manufactured iron, we can readily detect carbon, which does not exist in our specimen, and the situation in which it was found, is presumptive evidence that it was not manufactured, and the rocks around, not belonging to the class bearing metallic ores, it is impossible for it to have been derived from them, and it could not have been derived from the distant rocks by diluvial transportation, for no such ores exist in any of our mines.

Had it been an ore of iron, reduced by a blast of lightning, we should not have found it alloyed with nickel.

We are therefore led to conclude, that our specimen is of celestial origin, and that it is a fragment of one of those asteroids of cometary matter, which wandering in space, occasionally cross our orbit, and being attracted by the earth, so that they rush through our atmosphere, bursting into fire and descending, take up their abode on this sublunary sphere.

Boston, May 29th, 1838.

## Art. IX.—*Table of Greek Correlatives, accompanied with explanations;* by Josiah W. Gibbs, A. M., Professor of Sacred Literature in Yale College.

The name *Correlatives* is given to certain pronouns, pronominal adjectives, and pronominal particles, which have a reciprocal relation and correspondence to each other both in their forms and in their significations.

The name *pronoun*, (from Lat. pronomen, *for a noun;* comp. Gr. ἀντωνυμία,) which has come down from the ancient Latin and Greek grammarians, denotes a word used instead of a noun or name, to prevent its too frequent repetition. Although this appellation does not indicate the true nature of this part of speech, and seems to imply an error as to its origin; yet it is sufficiently accurate for practical purposes, inasmuch as the pronoun is now actually used where otherwise we should employ a noun or name. Whether we use the term *pronoun* or *substitute*, (scil. for a noun,) which some have proposed, is a point of minor importance.

But the name *demonstrative*, which modern writers on general grammar have adopted, is more descriptive of the true nature of this part of speech, which consists in *demonstrating* or pointing out, as it were, with the finger, the object, instead of naming it, as is done by the noun. It is probably more ancient than the noun, as is shown by its appearance in most languages, and therefore not strictly used instead of the noun. It differs from a noun in merely demonstrating, and not naming or describing a thing. It is, therefore, altogether impersonal and unreal, being permanently attached to no person, thing, quantity, quality, but completely abstract or vacillating.

The class of words with which we are now concerned, are therefore all demonstratives, in the general sense, inasmuch as they do not name any person, thing, quantity, quality, time, or place, but only *demonstrate* or point to it, as has been just explained.

| | I. Determ. | II. Demonst. | III. Interr. | IV. Indef. | V. Obj. Neg. | VI. Subj. Neg. | VII. Simp. Rel. | VIII. Comp. Rel. | IX. Univ. |
|---|---|---|---|---|---|---|---|---|---|
| **1. Pure Pronoun,** | ἵς or ἷς, | ὁ, | τίς, | τὶς, | οὔτις, | μήτις, | ὅς, | ὅστις, ὅτις, | ὅς ἄν, ὅστις ἄν. |
| | ἵς or ἷς, | ἡ, | τίς, | τὶς, | οὔτις, | μήτις, | ἥ, | ἥτις, ὅτις, | ἥ ἄν, ἥτις ἄν. |
| | ἵ or ἷ, | τό, | τί, | τὶ, | οὔτι, | μήτι, | ὅ, | ὅ, τι, ὅ, τι, | ὅ ἄν, ὅ, τι ἄν. |
| **2. Adj. of Preference,** | ἕτερος, | ——— | πότερος,<br>κότερος, Ion. | ποτερός, | οὐδέτερος, | μηδέτερος, | ——— | ὁπότερος,<br>ὁκότερος, Ion. | ὁποτεροσοῦν. |
| **3. Adj. of Quantity,** | ἴσος, | τόσος,<br>τοσοῦτος, | πόσος,<br>κόσος, | ποσός, | ——— | ——— | ὅσος, | ὁπόσος,<br>ὁκόσος, | ὅσος ἄν, ὁποσοσοῦν. |
| **4. Adj. of Quality,** | ἷος, | τοῖος,<br>τοιοῦτος, | ποῖος,<br>κοῖος, | ποιός, | οὐδείς, | μηδείς, | οἷος, | ὁποῖος,<br>ὁκοῖος, | οἱοσοῦν, ὁποιοσοῦν. |
| **5. Adj. of Country,** | ——— | ——— | ποδαπός, | ——— | ——— | ——— | ——— | ὁποδαπός, | ——— |
| **6. Adj. of Size or Age,** | ——— | τηλίκος,<br>τηλικοῦτος, | πηλίκος, | πηλικός, | ——— | ——— | ἡλίκος, | ὁπηλίκος, | ὁπηλικοσοῦν. |
| **7. Conjunction,** | ἵνα, | τό, | τί, | τὶ, | οὔτι, | μήτι, | ὅ, | ὅτι, | ὅτιοῦν. |
| **8. Adv. of Place** ***whence,*** | ἔνθεν,<br>ἐντεῦθεν, | τόθεν, | πόθεν,<br>κόθεν, | ποθέν,<br>κοθέν, | ——— | μήποθεν, | ὅθεν, | ὁπόθεν, | ὁποθενοῦν. |
| **9. Adv. of Place** ***where,*** | ἔνθα,<br>ἐνταῦθα, | τόθι, | ποῦ, πόθι,<br>κοῦ, | που, ποθί,<br>κου, | οὔποθι, | μήπου, | οὗ, ὅθι, | ὅπου, ὁπόθι, | ὁπουοῦν. |
| **10. Adv. of Place** ***whither,*** | ἐνθάδε,<br>ἐνταυθοῖ, | ——— | ποῖ, πόσε,<br>κοῖ, | ποι,<br>κοι, | ——— | ——— | οἷ, | ὅποι, ὁπόσε, | ——— |
| **11. Adv. of Place** ***through which,*** | ᾗ, εἰ, | τῇ, | πῇ, πᾶ,<br>κῇ, | πη, πα,<br>κη, | οὔπη,<br>οὐδέπη, | ——— | ᾗ, | ὅπη, ὅπα, | ὁπηοῦν. |
| **12. Adv. of Time,** | ἔτι, ἰδέ, ἠδέ, | τότε, τόκα, | πότε, πόκα,<br>κότε, | ποτέ, ποκά,<br>κοτέ, | οὔποτε, οὔποκα,<br>οὐδέποτε, | μήποτε,<br>μηδέποτε, | ὅτε, ὅκα, | ὁπότε, | ὁποτεοῦν, or<br>ὁποτοῦν. |
| **13. Adv. of Specific Time,** | ——— | τηνίκα,<br>τηνικαῦτα, | πηνίκα, | ——— | ——— | ——— | ἡνίκα, | ὁπηνίκα, | ——— |
| **14. Adv. of Manner,** | ——— | τώς, ὥς, | πῶς,<br>κῶς, | πως, πω,<br>κως, κω, | οὔπως, ω,<br>οὐδέπω, | μήπως, ω,<br>μηδέπω, | ὥς, | ὅπως,<br>ὅκως, | ὁπωσοῦν. |
| **15. Adv. of Number,** | ἰσάκις, | τοσάκις,<br>τοσαυτάκις, | ποσάκις,<br>κοσάκις, | ποσακίς, | ——— | ——— | ὁσάκις, | ὁποσάκις, | ὁποσακισοῦν. |

Each word in this table, it will readily be seen, consists of two parts; viz. the correlative element, which it has in common with other words in the same column, and the modifying element, which it has in common with other words in the same row or series. The tabular mode of exhibition which we have adopted, suggests a natural mode of discussing these words; which is, first, to treat of the correlative element in each column, and then to treat of the modifying element in each series. These elements, moreover, are to be considered severally, both as to their logical import, and as to their grammatical form. By this regular but thorough process, we hope to condense much into a little space, and to arrive at important general principles.

The I. column is incomplete, but very important and interesting, as exhibiting venerable reliques of an ancient and nearly obsolete pronoun. It contains *determinatives*, by which we intend weak or unemphatic demonstratives, like Eng. *he*, *she*, *it*, or Lat. *is*, *ea*, *id*. As the correlative import and form is often obscured, it may be useful to consider each member of this column separately.—1. The existence of a very rare pronominal root ἵ or ἴ, in the sense of Eng. *he*, *she*, *it*, or Lat. *is*, *ea*, *id*, is now admitted by the best Grecists, as Buttmann, (Ausf. Sprachlehre, B. II. p. 413.) and Passow, (Handwörterb. s. v.) Its existence is also confirmed by the analogy of the Sanscrit and other Indo-European dialects, as we shall hereafter see. But it is uncertain, whether the vowel of this root should have the rough breathing, ἵ, which accords best with the pronoun of the third person, οὗ, οἷ, ἕ, or the smooth breathing, ἴ, which accords best with some of the derivatives, as ἴσος, ἴος, etc. and with its form in cognate languages. The form of the pure pronoun was probably ἵς, ἵ, or ἴς, ἴ, like τίς, τί.*—2. The form ἕτερος, *other*, (as if *more* or *other than he*,) without doubt belongs here, although the *i* is lost in *e* (=*ai*;) comp. Sansc. *i-taras*, another, Lat. *i-terum*, again.—3. ἴσος, *like*, *equal*, (as if *so great*,) which we sometimes find as a correlative to ὡς, see Acts 11 : 17.—4. ἴος, *one*, (as if *of this kind*, *such*,) a form occurring in Homer for the numeral εἷς. The numeral for one, in most of the Indo-European languages, is of pronominal origin; as Sansc. *êka*, one, compounded of the demonstrative *ê* and the interrogative *ka*; Zend. *aêva*, one, connected with Sanscrit pronominal adverb *êva*, only; Goth. *ains*, Germ. *ein*, Eng. *one*, Gr. ἕν, Old Lat. *oinos*, Lat. *unus*, all derived from Sansc. *êna*, this.—5. No form extant.—6. No form extant.—7.

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* Max. Schmidt, (Comment. de Pronom. Graeco et Latino, p. 15.) endeavors to distinguish between ἵ demonstrative and relative, and ἴ the third personal pronoun, but I think without success.

ἵνα, primarily i. q. Gr. ὅτι or Lat. *quod*, and correctly derived by Passow from the old personal pronoun ἵς, ἵ.—8. Here *i* is lost in *e* (=*ai;*) comp. Sansc. *i-tas*, thence; Lat. *i-nde*, thence.—9. Here *i* is lost in *e* (=*ai;*) comp. Sansc. *i-ha*, here; Zend. *i-dha*, here; Lat. *i-bi*, there.—10. Here *i* is lost in *e* (=*ai;*) comp. ἔνθα.—11. The form ἤ, *either*, *or*, (as if *in this way*, *in that way*,) probably for ᾗ with subscript Iota, an obsolete dative from the pronominal root ἵ. The form εἰ *if*, (as if *in this way*, *under these circumstances*,) probably with form of the dative, from the same pronominal root. The vowel *i* in both forms is lost in *e* (=*ai*.) For examples of the derivation of the conditional conjunction from pronouns; comp. Sansc. *yadi*, if, from *yas*, who; *it*, if, neuter of the pronoun *i;* Goth. *ith*, if, for *ita*, neuter of the pronoun *is;* Germ. *wenn*, if, from *wer*, who.—12. The forms ἔτι, *yet*, ἰδέ and ἠδέ, *and*, (comp. Sansc. *i-ti*, also,) we place here, although with some hesitation.—13. No form extant.—14. No form extant.—15. The form ἰσάκις from ἴσος needs no illustration.—It ought here to be observed that ἔνθεν, ἔνθα, and probably the other forms in the 8th, 9th, and 10th series, are capable of the relative signification; comp. Germ. *der* and Eng. *that*, which are both demonstratives and relatives, the ground of which is worthy of further investigation.

Rem. 1. The lengthened forms, as ἐντεῦθεν, (Ion. ἐνθεῦτεν,) ἐνταῦθα, (Ion. ἐνθαῦτα,) ἐνταυθοῖ, (Ion. ἐνθαυτοῖ,) are more emphatic than the others.

Rem. 2. Some of the forms in this column are strengthened or rendered emphatic by the addition of δέ; as ἐνθένδε, ἐνθάδε. Add also ἐντευθενί, ἐνθαδί, ἐνθαυθί.

The II. column is not quite complete. It is, however, regular, beautiful, and worthy of admiration. It consists of *proper demonstratives*, an important and interesting class of words. They have sometimes been called *redditives*, as answering or responding to the interrogatives. But this name is inappropriate, as it would seem to imply an origin posterior to that of the interrogatives. The correlative element is expressed throughout by τ, a sound which is justly believed to have a natural appropriateness to perform this office. Hence it is found with remarkable uniformity in different families of the Indo-European stock of languages, as we shall hereafter see. The irregularity in the masculine and feminine forms of the pure pronoun is only apparent, for the form of the oblique cases, τοῦ, τῆς, τοῦ; τῷ, τῇ, τῷ, etc. plainly show that the nominative was originally τό, τή, τό.—It ought here to be observed in respect to the pure pronoun, that it is sometimes used as a relative, (comp. the remark on ἔνθεν and ἔνθα above;) and, in the genitive and dative singular, also as an interrogative and indefinite; and that although its primary sense is that of a demonstrative, yet it is generally weakened into that of a mere article.—The forms *τόθεν* and *τόθι* are also used as relatives.—*ὥς*, although placed in this column, is from *ὅς*, *ἥ*, *ὅ*, used as a demonstrative. Comp. Rem. 6. below.

Rem. 3. The lengthened forms, as *τοσοῦτος*, *τοιοῦτος*, *τηλικοῦτος*, *τηνικαῦτα*, *τοσαυτάκις*, are more emphatic than the others.

Rem. 4. Many of the forms in this column are also strengthened or rendered emphatic, by the addition of *δέ*; as *ὅδε*, *τοσόσδε*, *τοιόσδε*, *τηλικόσδε*, *τηνικάδε*. Add also *τοιοσδί*, *τοιουτοσί*, *τηλικουτοσί*.

The III. column is complete. It consists of *interrogatives*, which are a very peculiar class of words. An interrogative sentence is not a full or complete proposition in itself, but is an imperfect proposition or assertion, which is offered to another to complete or fill up. The interrogative element in Greek has three forms; viz. initial *τ*, which is found alone in the first and seventh series, initial *κ* and *π*, which are found together in each of the other series, and probably once existed also in the first and seventh series. Of these forms we shall treat separately.—(1.) The oldest of them is *κ*, which is retained in the Ionic dialect, and is found abundantly in the other Indo-European languages. This letter is justly supposed to have a natural appropriateness to perform the function of an interrogative. Hence we are not to regard this column as formed from the second column, but as having a coetaneous origin with it. It differs from it not by inflection or derivation; but, if I may so speak, by correlation. A leading letter of one organ is exchanged for a leading letter of another organ, each having its own natural significancy.—(2.) A second form is initial *π*, which seems to have usurped the place of *κ* in all the Greek dialects except the Ionic. As this form has arisen, not by the commutation of one letter for another of the same organ, but by the commutation of a letter of one organ for the corresponding letter of another organ, it seems to require some illustration and confirmation. The following are examples of the interchange of *k* and *p*: Sansc. *ap*, Lat. *aqua*, water; Sansc. *pangtsha*, Arab. *khams*, Æol. *πέμπε*, Lat. *quinque*, Welsh *pump*, Ir. *kuig*, five; Gr. *ἕπομαι*, Lat. *sequor*; Gr. *ἧπαρ*, Lat. *jecur*; Gr. *λείπω*, Lat. *linquo*; Gr. *ἵππος*, Lat. *equus*; Gr. *πέπω*, Lat. *coquo*; Gr. *πέτορα* for *τέσσαρα*, Lat. *quatuor*; Gr. *λύκος*, Lat. *lupus*; Gr. *σηκός*, Lat. *sepes*; Gr. *σκῦλα*, Lat. *spolia*; Gr. *σφηκάς*, Lat. *vespas*; Oscan *pitpit*, Lat. *quidquid*; Ir. *keann*, Welsh *pen*, the head. There can be no doubt that there is a physiological ground for this change, in the similar state of the organs of speech.—(3.) A third form is initial *τ*, in the first and seventh series, which seem to be formed from the first column by correlation. That *κ* was even here the original form seems to be shown by the analogous

Latin form, *quis, quis, quid.*—It ought here to be observed, in regard to the interrogatives generally, that they are sometimes employed in the indirect inquiry. Thus 1. *τίς*, Acts 21 : 33. 2. *πότερος*, Hom. Il. V. 85. John 7 : 17. 3. *πόσος*, Acts 21 : 20. 4. *ποῖος*, John 12 : 33. 6. *πηλίκος*, Gal. 6 : 11. 7. *τί*, Mat. 21 : 16. 8. *πόθεν*, Luke 13 : 25. 9. *ποῦ*, Mat. 2 : 4. 12. *πότε*, Mark 13 : 33. 14. *πῶς*, Mat. 6 : 28. This use of the interrogative makes a sort of transition or approximation to the relative, but must be carefully distinguished from it.

The IV. column, which is nearly complete, consists of *indefinites*, a class of words more easy to apprehend by usage, than to describe by definition. They are said to denote an object, in a general manner, without expressly indicating a particular individual. The Greek indefinites have three shades of meaning, which in other languages are distinguished from each other. Thus 1. *τὶς* is either (1.) an universal indefinite, i. q. Lat. *quisquam*, Eng. *any one;* 1 Cor. 6 : 1. Rom. 5 : 7 init. (2.) a particular indefinite, i. q. Lat. *aliquis*, Eng. *some one;* Acts 3 : 5. Rom. 5 : 7. fin. or (3.) a particular indefinite, so described, although definitely known, i. q. Lat. *quidam*, Eng. *a certain one;* Luke 8 : 27, 49. 12. *ποτέ* signifies either (1.) *at any time*, Lat. *unquam*, Eph. 5 : 29. Heb. 1 : 5, 13. (2.) *at some time*, Lat. *aliquando*, Luke 22 : 32. or (3.) *at a certain time*, Lat. *quondam*, Eph. 2 : 13.—The form of the Greek indefinites agrees with that of the interrogatives in every respect, except that the interrogatives have the accent nearer to the beginning of the word, and the indefinites nearer to the end.

The V. and VI. columns consist of *negatives*, which are formed directly from the indefinites in their first and leading import. The V. column is formed by *οὐ*, (Sansc. *vi, vahis*,) to express objective or absolute negation, and the VI. column is formed by *μή*, (Sansc. *ma*,) to express subjective or conditional negation. I am not aware that this distinction exists in any other language.

Rem. 5. There are other forms compounded of *μή* interrogative, which must not be confounded with these made up of *μή* negative; as *μήτις*, John 4 : 33. *μήποτε*, John 7 : 26.

The VII. column consists of *relatives*, a class of words which perform a very important office in connecting discourse. As they serve to subjoin one sentence to another which is previous, they have by some writers been properly called *subjunctives*. The relative element in Greek consists of an aspiration or rough breathing, which I regard as a softening of the hard palatal in the interrogative class. In some other languages, as the Latin and the Teutonic, the interrogative and relative agree substantially in form, the principal difference being in the accent or intonation. That the interrogative is prior to the relative in the order of nature, is shown by the use of the interrogative in the indirect inquiry and as the indefinite, which make, as it were, the transition to the relative. It is also shown by the origin of the compound relative.—The relative pronoun has been explained by some as equivalent to a personal pronoun preceded by a copulative conjunction, and the Lat. *qui* (*quis*) has even been derived from *καί* and *ὁ*, or *que* and *is*. But the philosophical explanation is inadequate, as the sentence introduced by the personal pronoun and copulative conjunction, is co-ordinate, while that introduced by the relative pronoun is subordinate, and the derivation has been better explained above.

Rem. 6. The simple relatives are sometimes employed as demonstratives. Thus ὅς, 2 Cor. 2 : 16.

The VIII. column, which is complete, contains what are called *compound relatives*. They are formed, I apprehend, by prefixing ὁ or ὅς to interrogatives or indefinites of the later formations; as ὅστις or ὅτις from τίς, ὁπότερος from πότερος; sometimes to those of the earliest formation; as ὅκως from κῶς. In use they appear not to differ from the simple relatives; except ὅστις, which often has the force of an universal.

Rem. 7. The π, and τ, of this column, are sometimes doubled for the sake of increasing the quantity of the preceding syllable.

The IX. column contains *universals*, which are formed from the simple and compound relatives by certain syllabic adjections; as (1.) ἄν or ἐάν, *perhaps, by chance;* (2.) γέ, *indeed, at least;* (3.) δή, *now, then;* (4.) δήποτε, *now at any time;* (5.) δηποτοῦν, *now at any time indeed;* (6.) κέ or κέν, i. q. ἄν; (7.) οὖν, *then;* (8.) οὖν δή, *then indeed;* (9.) πέρ, *ever:* (10.) ποτέ, *ever, at any time;* (11.) τισοῦν, *any one then.*

Thus ὅς is strengthened or rendered an universal, by ἄν or ἐάν, δήποτε, κέ, πέρ.—ὅστις by ἄν or ἐάν, γέ, δή, δήποτε, δηποτοῦν, οὖν, πέρ, ποτέ.—ὁπότερος by οὖν, δήποτε; (comp. Lat. *uter*, strengthened by *vis, libet, cunque*, or by repeating *uter*.)—ὅσος is strengthened by ἄν, δή, δήποτε, πέρ.—ὁπόσος by δήποτε, οὖν, τισοῦν.—οἷος by δήποτε, οὖν.—ὁποῖος by δή, δήποτε, δηποτοῦν, οὖν, οὖν δή.—ὁπηλίκος by οὖν.—ὅτι by οὖν.—ὁπόθεν by οὖν.—ὅπου by οὖν.—ὅπη by οὖν.—ὁπότε by οὖν.—ὅπως by οὖν.—ὁποσάκις by οὖν.

The 1st series or row contains *pure pronouns*, as distinguished from the other series, in which the pronominal idea is mixed with something foreign. They are formed from the pronominal root by the simple addition of the sign of case. For the sake of completeness, we distinguish in the table the three genders of the nominative.

The 2d series contains *adjectives of preference*, which combine the pronominal idea with that of number. They are a sort of comparative degree made from the pure pronoun, by adding τερος, (comp. Sansc. *taras*, Zend. *tara*, Pers. *ter*, Lat. *terus*, Slav. *toryi*, Lithuan. *tras*.) Such formations are found in other Indo-European languages; as Sansc. *kataras*, Lat. *uter*, *neuter*, *alter*, *ceterus*; Slav. *kotoryi;* Lithuan. *katras*, Goth. *hwathar*, Old Germ. *huedar*, Eng. *whether*. Comp. also other similar forms in Greek; as ἀμφότερος, *both;* ἑκάτερος, *each of two*, *either*.

Rem. 8. It ought here to be observed, that just as the first series gives rise to the other series by immediate derivation, so this series in like manner has a variety of derivatives, which are analogous to those of the first series, and form a kind of triple compounds. Thus are derived I. from ἕτερος, ἑτεροῖος, *of another kind;* ἑτέρωθεν, *from the other side;* ἑτέρωθε, *on the other side;* ἑτέρωσε, *to the other side;* ἑτέρᾳ and ἑτέρηφι, *in another way;* ἑτέρως, *otherwise*, (whence ἑτεροίως, *in another manner;*) ἑτεράκις, *at another time;* III. from πότερος, πότερον, *whether?* ποτέρωθι, *on which of the two sides?* ποτέρωσε, *to which of the two sides?* ποτέρως, *in which of two manners?* V. from οὐδέτερος, οὐδετέρωθεν, *from neither side;* οὐδετέρωσε, *to neither side;* οὐδετέρως, *in neither manner;* VI. from μηδέτερος, μηδετέρωθεν, *from neither side;* μηδετέρωσε, *on neither side;* μηδέτερως, *in neither manner;* VIII. from ὁπότερος, ὁποτέρωθεν or ὁποτέρωθε, *from which side;* ὁποτέρωθι, *on which side;* ὁποτέρωσε, *to which side;* ὁποτέρως, *in which of two ways;* IX. from ὁποτεροσοῦν, ὁποτερωθενοῦν, *from whichever side.* The number of forms is in this way greatly augmented.

The 3d series contains *adjectives of quantity*. They appear to be formed by a reduplication of the pure pronoun; thus ὅσος from ὅς. Comp. Lat. *quisquis*, where the repetition denotes universality; and some cases in Hebrew, where the repetition denotes distribution.—ἴσος in the I. column has nearly lost its original import, and denotes *equal, like*.—The other columns have the following shades of meaning; (1.) concrete quantity, or magnitude; (2.) discrete quantity, or number; (3.) time; (4.) intensity; (5.) more metaphorical significations.

Rem. 9. From πόσος of the III. column are derived πόστος, *of what number?* ποσταῖος, *of what day?* from ὁπόσος of the VIII. column, ὁπόστος, *of what number;* ὁποσταῖος, *of what day;* from ὁποσοσοῦν of the IX. column, ὁποστοσοῦν, *of whatsoever number;* thus helping, as it were, to form new series of triple compounds.

Rem. 10. The σ of this series is sometimes repeated for the sake of increasing the quantity of the preceding syllable.

The 4th series contains *adjectives of quality*. They are formed from the Ionic genitive of the pure pronoun; thus τοῖος from τοῖο, οἷος from οἷο. Comp. ἐμός from ἐμοῦ, δημόσιος from δήμου, anciently δημοσιο; Lat. *meus* from *mei; cujus, cuja, cujum,* from *cujus*, genitive of *qui.*—ἴος in the I. column has nearly lost its original import, and signifies *one.*—I insert οὐδείς in V. column and μηδείς in VI. column, on account of their relation to ἴος in the I. column, but I do it with hesitation.—The other columns have two shades of meaning, (1.) simple quality; (2.) quality with distinction.

Rem. 11. From τοῖος of the I. column is derived τοίως, *in such a manner;* from τοιοῦτος of the I. column, τοιούτως, *in such a manner;* from ποῖος of the III. column, ποίῃ, *in what kind of way?* a sort of triple compounds.

Rem. 12. This series might be extended by adding ἀλλοῖος, *of another kind.*

The 5th series, which is incomplete, contains *adjectives of country.* They are formed from the pure pronoun, perhaps in the genitive, by postfixing the preposition ἀπό, and inserting δ to prevent the hiatus; thus ποδαπός for που(δ)απο(ς); ὁποδαπός for ὁπου(δ)απο(ς); comp. ἀλλοδαπός, *from another country;* ἡμεδαπός, *from our country;* παντοδαπός, *from every country;* τηλεδαπός, *from a far country,* ὑμεδαπός, *from your country;* also ἐχθοδοπός, *from a hostile conntry.*

The 6th series contains *adjectives of size* or *age.* They are formed from the pure pronoun by means of λικ, (=Goth. *leiks*, Eng. *like.*)

The 7th series is a regular formation, which is deserving of attention. The technical distinctions of grammarians have separated the different members of this series in such a way, that their analogy has not always been perceived. I have called them *conjunctions;* but they are in fact *a sort of article* prefixed to sentences, as the common article is prefixed to nouns. They are the neuters singular or plural of the corresponding pure pronoun in the first series. The following are examples of their use; I. ἵνα, as, συμφέρει ὑμῖν, ἵνα ἐγὼ ἀπέλθω, *it is expedient for you, that I go away,* John 16: 7. (2.) τό; as, εἰσῆλθε δὲ διαλογισμὸς ἐν αὐτοῖς, τὸ, τίς ἂν εἴη μείζων αὐτῶν, *now there arose a contention among them,* (*to wit,*) *this, which of them should be greatest,* Luke 9: 46. VIII. ὅτι; as, αὕτη δέ ἐστιν ἡ κρίσις, ὅτι τὸ φῶς ἐλήλυθεν εἰς τὸν κόσμον, *and this is the condemnation, that light has come into the world,* John 3: 19.

The 8th series contains *adverbs of the place whence.* They terminate in θεν, (=Sansc. *tas*, Lat. *tus*, Slav. *du;*) comp. ἄλλοθεν, ἄνωθεν, κάτωθεν, οὐρανόθεν.

Rem. 13. The form ἔνθεν is used also of time and causality or condition.

The 9th series contains *adverbs of the place where.* It has two formations; one that of the genitive case, as *ποῦ;* the other that in *ϑι*, (=Sansc. *d'i*,) as *πόϑι;* comp. *ἄλλοϑι, οὐρανόϑι.*

Rem. 14. The form *ἔνϑα* is used also of time.

The 10th series contains *adverbs of the place whither.* It has two formations; one an ancient dative, as *ποῖ;* the other in *δε* or *σε*, as *ἐνϑάδε, πόσε;* comp. *ἄλλοσε, οὐρανόνδε.*

The 11th series contains *adverbs of the place by* or *through which.* They are all datives feminine singular from the pure pronoun, used as the instrumental, *ὁδῷ* being understood. They should be written with subscript Iota, wherever the primitive is in use. This same case may denote the place *where* or *whither.* Comp. Lat. *eâ*, scil. *viâ*; *quâ*, scil. *viâ.*

The 12th series contains *adverbs of the time when.* All of them (excepting column I.) are accusatives neuter singular, with the syllabic adjection *τε.* Comp. *τόφρα*, (compounded of *τό* and *φρα;*) *ὄφρα*, (for *ὅφρα*, compounded of *ὅ* and *φρα;*) Lat. *tum*, (=Gr. *τόν;*) *tunc*, (analogous to *hunc;*) *quum*, (as if accus. from *quis;*) *dum; nunc*, (analogous to *tunc;*) *num*, (in *etiamnum;*) Goth. *than*, (whence Eng. *then*,) accus. sing. masc. for *thana.*

Rem. 15. *τότε* and *ὅτε*, with *μέν* and *δέ*, are accented thus, *τοτέ* and *ὁτέ*, and have the same signification as *ποτέ* indefinite.

Rem. 16. *τόκα, πόκα, ποκά, οὔποκα, ὅκα*, are Doric forms.

Rem. 17. The *τ* or *κ* is sometimes doubled; as, *ὅττε, ὅκκα.*

Rem. 18. This series easily slides into the sense of condition, circumstances, or cause.

The 13th series contains *adverbs of the time* or *hour of the day.* They are probably derived from lengthened forms, as *τῆνος, πῆνος*, etc. by adding the termination *ικα*, comp. *αὐτίκα, πρόκα.* They appear to denote, (1.) the time *when* generally; (2.) the time or hour of the day specifically.

Rem. 19. From *τῆνος* are also derived *τηνεί*, and *τηνόϑι*, *there; τηνόϑεν, τηνῶϑεν*, and *τηνῶϑε*, *thence.*

The 14th series contains *adverbs of manner* or *likeness.* They are ancient ablatives, used as modals, all ending in *ως*, (Sansc. *ât*, Zend. *t*, Old Lat. *d;*) comp. *καλῶς, κακῶς*, etc.

Rem. 20. Columns II. IV. V. VI. VIII. IX. easily slide into the sense of time.

Rem. 21. Columns VII. VIII. IX. easily slide into the sense *how that, so that, that, because that, in order that*, etc.

Rem. 22. The indefinite form *πως* is enclitic and to be written without an accent. See Passow. Buttmann, however, adds an accent.

**Rem. 23.** *πως* and *πω* appear to me to have the same meaning, and to have been originally the same word, the latter being derived from the former by apocope. I see no reason either for making the termination *ως* an old accusative form, as Passow supposes, or *πω* an old Doric genitive, as the same lexicographer has done.

The 15th series contains *adverbs of number*. They are formed immediately from the 3d series or adjectives of quantity, by adding the termination *κις*, (=Sansc. *s'as*, Lithuan. *gis*;) comp. *τετράκις*, *πεντάκις*, *πολλάκις*, etc.—*ισάκις* has various meanings; (1.) *as often;* (2.) *as many;* (3.) *equally;* (4.) *in as many ways.*

**Rem. 24.** The medial *σ* of this series is sometimes doubled for the sake of the measure; as *τοσσάκις*, *τοσσάκι*, *ὁσσάκι*. Comp. Rem. 10. supra.

**Rem. 25.** The final *ς* is sometimes dropped before a consonant for the sake of the measure; as, *τοσσάκι*, *ποσάκι*, *ὁσάκι*.

The appearance of these correlatives in the cognate Indo-European languages will be reserved for a future number.

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## Art. X.—*First Annual Report on the Geological Survey of the State of Ohio;* by W. W. Mather, principal Geologist, and the several Assistants. pp. 134. Columbus, Ohio.

(Communicated.)

This document reflects credit not only on the board, by which it was prepared, but the state by whose munificence they were enabled to prosecute their researches. It embodies a mass of valuable and well digested facts, collected during the geological investigations of the past season. These facts are of a practical character, and directly applicable to the arts. Technical terms, and theoretical speculations, as a general thing, seem to have been sedulously avoided. We propose to lay before our readers an abstract of this valuable document, as well as to notice some statements, which conflict with our own observations.

The corps was organized last June. Prof. W. W. Mather of New York, was appointed chief or superintending Geologist. Subordinate to him were four assistants proper, one acting assistant, and one topographical engineer. For the better attainment of the objects of the survey, several distinct departments were created. To Dr. S. P. Hildreth, of Marietta, was assigned the department of palæontology. To Dr. J. P. Kirtland of the Cincinnati Medical College, that of botany and zoology. Dr. John Locke of Cincinnati, was in Europe at the time of his appointment, and did not return in season to enter upon the duties of the survey.

Prof. C. Briggs, Jr., of New York was appointed fourth assistant. J. W. Foster, Esq., of Zanesville was appointed acting assistant, and associated with Mr. Briggs in the survey of the district between the Scioto and Hockhocking rivers. To Col. Charles Whittlesey of Cleveland, was assigned the topographical department of the survey.

Such is the present organization of the board; and from the reputation of the several gentlemen employed, we doubt not that their labors will be instrumental in stimulating the industry, and developing the resources of a great and growing state. With these prefatory remarks, we proceed to notice the several reports, embraced in this document.

The report of Prof. Mather, comprises a description of the principal formations in the State—the value, range and extent of the coal and iron deposits—the best method of fluxing ores,—the chemical composition, and mechanical texture of soils—the application of marls as a manure, and a variety of interesting details, which our limits will not permit us to particularize. Coal is one of the most valuable and widely diffused minerals in the eastern section in the State. In reference to this, he says:—

> "From the reconnaissance of the past season, it is estimated that about 12,000 square miles of the state, are undoubtedly underlain by coal, and 5,000, by workable beds of this valuable mineral. In many places, several successive beds of the coal are superposed one over the other, with sandstone, iron ore, shale and limestone intervening. The coal beds are favorably situated for working, as they are found in the hills and ravines, where they can be drained with little expense, and without deep shafts and expensive machinery, like those of Europe, or some parts of our own country. It is impossible, with the data as yet ascertained, to estimate the amount of workable beds; but probably a mean thickness of six feet of coal capable of exploration over 5,000 square miles, is a moderate estimate of our resources in this combustible. Our citizens are not yet aware of the prospective value of coal lands; and it is, perhaps, only by setting their practical utility before them, that they will appreciate the importance of this mineral on their estates."
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> "Every square mile, containing two yards in thickness of workable coal, will yield about 6,000,000 tons, which is an abundant annual supply

of fuel for all the people of this state, both for domestic and manufacturing purposes; and, if we allow double this amount for prospective consumption, in consequence of increased population and manufactures, we have coal within a moderate depth, sufficient for consumption during 2,500 years. If we consider the value of coal as a means of *motive power* in propelling machinery, each acre, of the 5,000 square miles of coal, contains stored and ready for use, a power equal to that of one hundred and ninety two men for one hundred years, working ten hours per day. Allowing a profit of only twenty five cents on each cubic yard of coal, an acre would yield a profit of more than $2,000 where a depth of six feet is worked.

"These facts will, it is hoped, lead our citizens to appreciate the vast mineral resources in this valuable combustible, with which our territory through Infinite Wisdom, is so bounteously supplied." pp. 5, 6, 7.

The estimate is very far too low, not only as to the area, traversed by the coal, but its mean thickness. As many as six distinct beds or seams of workable coal crop out successively, as you travel from east to west. These beds vary in thickness from 2½ to 8 feet. Thus, we think that 20 feet of workable coal, over an area of 8,000 square miles, would be a nearer approximation to the truth.

But perhaps the most interesting fact in this report, in a geological point of view, is the degradation of the land, bordering on Lake Erie. In many places, the encroachment of the lake has been so rapid, within a few years, as to become a formidable evil. From the difficulty of opposing a barrier to these encroachments, many towns are threatened with demolition.

"The shore at Cleveland is washing away rapidly in front of the town. The cliffs, undermined by the surf and land springs, crack off at the top and slide partly down, so as to come within the action of the surf, while other slides from above, continue to push it farther and farther into the lake, until all is carried away by the waves and shore currents. Slides occur every year. Several rods, in width, have slidden down and been washed away within a few years.

"Attempts have been made to arrest this degradation, which threatens to remove the site of the city in the course of a century or two, unless it be checked. If piers be erected at intervals, extending out for one hundred to one hundred and fifty yards from the shore, and well filled in, alluvial deposits from the sand swept coastwise by the surf and shore currents, will necessarily be deposited in the eddies formed by these obstructions. An example of the application of this principle may be seen on the west side of the pier which protects the harbor, where several acres of alluvial land have been formed within four years. As the coast west of Cleveland is rock-bound, very little detrital matter is swept eastward, while the coast to the east of Cleveland, to Fairport, composed of earthy materials, is mostly in a state of rapid degradation. The northeast winds sweep this detrital matter along to the westward, and deposit it behind the obstacles which create eddy currents. The long pier at Cleveland has caused such currents, and the deposit of the alluvial sands just mentioned.

"One evidence that the lake has been making encroachments on this part of the coast for a long time, is an isolated hillock, a part of the original shore, which was also the boundary of a bluff on the Cuyahoga river. This bluff turned the river westward, so that its mouth was a mile or more west of Cleveland, and remaining without degradation on the river side, (as is evident by its moderate slope,) was washed away on the lake shore, until it was cut through at the bend, and gave the river a shorter course to the lake through a new mouth. The old mouth is closed by a sand beach, and the alluvial ground mentioned as having been formed west of Cleveland, is partly in front of the hillock, which presents a nearly vertical escarpment towards the lake.

"The evidence of the degradation of land by the surf on the shore, may be seen at any time by standing on the cliff at Cleveland (and at many other points on the coast) and looking off upon the lake. At the the distance of one-half to one mile from the shore, a distinct line may be seen to mark the division between the muddy water, produced by the washing away of clay and the grinding up of pebbles on the coast, and the clear blue water of the lake. All the water between that line and the shore is tinged with finely divided matter in a state of suspension. This matter settles in still water, and probably forms clay on the bottom of the lake, imbedding shells and other organic remains." pp. 16, 17.

We should be pleased to multiply extracts from this report, but our limits forbid. In it, we find the same accuracy of observation and the same scrupulous regard to facts, unbiassed by theory, which characterize the productions of that gentleman.

The next report is that of Dr. Hildreth. This gentleman, we regret to say, has resigned his situation in the survey, in consequence of ill health. He has long been an assiduous and successful cultivator of the natural sciences, and his several contributions to this Journal, have introduced us to a rich geological field, which has been hitherto, but partially explored. While we accord to him as a general thing, the character of a judicious and accurate observer, from some of his conclusions, we must be allowed to dissent. Thus, page 26, referring to the rocks which overlie the coal, he says:—"They are the new red sandstone, lias, oolite, &c. The *two* latter are rocks which have been very partially, or more probably not deposited at all, over the coal measures of Ohio." Thus asserting, by *implication* at least, that the new red sandstone exists in Ohio. In the 29th Vol. of this Journal, if we recollect right, the writer suggests that we may have an equivalent of the sandstone of the Connecticut valley, in the valley of the Ohio. This, he founds on the coincidence of the two rocks in lithological character. We have seen no formation in Ohio, which we have thought equivalent to the new red sandstone, and we have had an opportunity of studying both formations attentively. While the sandstone of the Connecticut valley agrees in many important particulars,* with that containing the zechstein of Germany, and the new red sandstone of England, it differs, so far as our observations extend, from any formation in Ohio, in its lithological characters, in its associated minerals and in its organic remains. The prevailing color† of the former is a deep red, sometimes variegated—that of the latter, white—but occasionally tinged. The same difference is observable in the respective shales of the two formations. Copper is a common mineral in the new red sandstone of the Connecticut valley. In Ohio, we have detected it but in a single instance, and that in a small quantity. In the former, bituminous marlite is common—in the latter, we find nothing which approaches it. In the former, satin spar often forms a thin lamina with the shale;—in the latter, never. The same diversity exists with regard to the organic remains. The rocks, which crop out on the eastern part of Ohio, we regard as the most modern, with the exception of the recent and tertiary formations. Here the dip is E. S. E., nor is there an anticlinal axis between this and the western border of the State. Yet in these rocks occur the Producta and the Spirifer—fossils characteristic of an older formation than the new red sandstone. The new red sandstone is characterized by a scarcity of organic remains. In Ohio, they are profusely scattered throughout all the rocks. In Ohio, no mammifers, and indeed, no vertebrata have been found.‡

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* Hitchcock's Geol. Mass. p. 212.

† Color is a character of little value among rocks, especially in the sandstones.—Eds.

‡ Ichthyolites are said to have been found in the buhr of Ohio, but this needs confirmation. They are the only vertebrata as yet found below the new red sandstone. There can be no doubt, from the imbedded fossils, that the buhr of Ohio, is a member of the coal series.

In the sandstone of the Connecticut valley, ichthyolites (*Palæothrissa macrocephala*) occur abundantly. Besides, according to Professor Hitchcock, the bones of a vertebrated animal, several feet in length, and not at all fossilized, have been found. In addition to this, ornithichnites* are found, the occurrence of which, while it draws line of demarkation between that formation, and the old red sandstone, must separate it from any formation in Ohio. For these reasons, we think that the new red sandstone of the Connecticut valley, cannot have an equivalent in Ohio—that the two formations were produced at distinct geological epochs, and under circumstances widely different.†

One of the principal topics embraced in Dr. Hildreth's report, is the range and extent, as well as the economical value of the buhr, or, as he terms it, the calcareo-silicious deposit. "It is," he justly remarks, "one of the most interesting features in the geology of the coal measures of Ohio, and like the meridian line in geography, will afford a valuable guide in developing the rock strata which lie beneath, or are superimposed on this deposit." This is a protean rock, at one time assuming a cellular aspect, with little or no admixture of calcareous matter, and again passing into a compact cherty limestone. Yet we are assured, (p. 29,) that under every aspect it may be known by the imbedded fossils which accompany this rock in its whole course. The fossils, he afterwards informs us, *peculiar to* this deposit, are Encrini, Producti, Spiriferi, Terebratulæ, &c. Here we remark, that particular fossils are characteristic of particular formations; but we have not sufficient evidence to believe that the particular members of a group have their peculiar fossils. We have noticed all the fossils enumerated, in the mountain or carboniferous limestone, which underlies the coal measures of Ohio, in many of the iron ores interstratified with them, in the blue limestone below the buhr, in the limestone in contact with it, and some of the fossiliferous limestone imposed upon it. As an article of traffic, Dr. Hildreth says:

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* Some few individuals have attempted to throw discredit on these discoveries of Professor Hitchcock; but, for ourselves, we regard the existence of ornithichnites as clearly settled as that of the orthoceratite or productus. An inspection of the Professor's specimens we think, must convince the most incredulous. While we regard it as one of the most interesting discoveries which has recently been made in geology, we deprecate every attempt captiously, and without the examination of the evidence, to detract from the well earned reputation of the author.

† The writer has not informed us to what place he would refer this sandstone.—Eds.

> "The importance of this article in a commercial and domestic point of view, may in some measure be estimated, when it is stated by intelligent persons, who have been long engaged in the manufacture of mill-stones, that the annual amount of the manufactured article is not less than $20,000; and that it may be safely calculated at this sum, for twenty years past. When to this, is added the money saved to mill-owners, from the use of the native instead of the foreign buhr-stone, that amount will be nearly doubled. It came into use about the year 1807. The early manufactured mill-stones were made of a single piece; but these often proving to be of unequal density, and not making good flour, were abandoned, and staves constructed of separate blocks, cemented with plaster, and confined togther with iron bands. Where these blocks are selected with care, by an experienced workman, the flour is said to be equal in quality to that made by the French stones.
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> "From the year 1814 to 1820, the price of a pair of four and a half feet stones was $350, and a pair of seven feet, sold for $500; while the foreign article sold for a still higher sum. The four feet stones now sell for $150. In the townships of Richland, Elk and Clinton, a large number of the inhabitants are engaged in the dressing of blocks, and in the construction of mill-stones. The buhr-rock is a mine of wealth to the inhabitants, and has contributed largely to the prosperity and independence of this whole region of country. The manufacture of mill-stones is not confined to the waters of Raccoon, but is also carried on to considerable extent in Hopewell township, Muskingum county. The quantity is apparently inexhaustible, and new quarries will be opened, at points where it is not at present looked for, and probably of a more even and compact texture than that now obtained. Few or no quarries have been yet worked by drifting under the sides of the hills, but the rock is generally procured by what is technically called "stripping," or excavating the superincumbent earth, near the top of some ridge or hill, where it is easy of access." p. 33.

His remarks on the salt springs are copious and interesting; but we must pass them without comment. In taking leave of this report, we express our pleasure in its perusal, and our conviction that it will enhance the well-founded reputation of Doctor Hildreth, as a scientific observer.

The report of Dr. Kirtland, from the nature of his department, does not admit of much detail. He has briefly and succinctly set forth some of the advantages which may be expected to arise from an investigation of the zoology and botany of Ohio. From it we make but a single extract.

> "By knowing the habits of insects, we can often obviate their attacks. The farmer may find it advantageous, in those sections of the state where the Hessian fly is common, either to postpone sowing his seed until the time for depositing the egg of the insect has passed, or to substitute spring for winter wheat; and it is also probable that some of the winter varieties of this grain may yet be found with stalks so solid that they will resist the attacks of this enemy. Many years since, the timber in the navy yards of Sweden was rendered unfit for use by the perforations of a small worm. The government applied to Linnæus for a preventive of its attacks. He recommended to have the timber sunk in water during the few days that were occupied by the insect in depositing its eggs. The remedy was perfectly effectual; and, simple as it was, saved more than a million of dollars annually to his country." pp. 68, 69.

The report of Mr. Briggs embraces all the economical facts collected by him and Mr. Foster, on the detailed survey of the southern portion of the State. There is an accompanying section to illustrate the superposition of the rocks between the great limestone deposit and the upper part of the coal series.

With respect to geological sections, says De La Beche, too much stress cannot be laid on the importance of rendering them as conformable to nature as circumstances will admit: that is, the perpendicular elevations and base lines should be, as much as possible, in proportion to each other. Without this necessary precaution, such sections are little better than caricatures of nature, and are frequently much more mischievous than useful, even leading those who make them to false conclusions, from the distortions and false proportions of the various parts. * * * It is clearly in the interest of science that they should be what they pretend to be, miniature representations of nature.* To this section we have three objections. 1. The strata are indicated without reference to relative thickness. 2. They are represented as nearly horizontal with a uniform dip of 30 feet per mile, whereas they are more or less undulating. We think that these physical features of the country could have been indicated on the section. Our third objection is of a more serious character. The conglomerate is erroneously represented as extending nearly to Bainbridge; whereas the outcrop of the conglomerate is a few miles west of Jackson, a distance of more than twenty miles east of its termination on the section. Not a vestige of it is to be seen *in situ*, even on the highest hills in the vicinity of Chilicothe.

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* Geol. Manual, Phila. ed. 1832, p. 519.

We propose to lay before our readers a description of the principal formations in Ohio, beginning with the oldest rocks and ascending in the series.

I. *Great Limestone Deposit.*—This is the equivalent of the mountain or carboniferous limestone of Europe. It is first struck in Adams county, and extends thence to the western borders of the State. It is of a grayish color, with a tinge of blue, and subcrystalline in its texture. It generally occurs in layers, varying from a few inches to two feet in thickness, with thin seams of shale intervening. From its toughness, it forms a valuable building material. Organic remains are profusely scattered throughout this deposit. Of *Zoophytes*, the principal are the *Caryophylla, Turbinolia, Cyathophyllum, Favosites*, and *Astrea*. Of the *Crustacea, Trilobites* and *Calymene*. Of *Mollusca*, the *Spirifer, Producta*, and *Terebratula*. Of *Conchifera*, the *Melaina, Delphinula, Planorbis, Orthoceratites, Ammonites*, and *Turritella*. On some of this limestone we have noticed ripple marks, which were probably contemporaneous with its induration.

From the appearance of this limestone, it is not unreasonable to suppose that the particles composing it were once held in aqueous solution, and subsequently deposited in tranquil water along the bottom of the ocean. This *may* have been consolidated by subterranean heat, acting on the mass. This is rendered *probable*, by the ingenious experiments of Sir James Hall. From them we derive the following conclusions: that a compressing force equal to the weight of 52 atmospheres, or 1700 feet of sea, is sufficient for the formation of limestone, if a due degree of heat be applied; that under 86 atmospheres, or about 3000 feet of water, a complete marble may be formed; and lastly, that, with a pressure of 173 atmospheres, or 5700 feet, a little more than a mile of sea, the carbonate of lime is made to undergo complete fusion, and to act powerfully on other earths. These compressions are, comparatively, by no means great. The force of gunpowder, at the least estimate, is equal to the weight of 1000 atmospheres.*

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* Edinburgh Rev. vol. 9, p. 27, Art. Sir James Hall on the Effects of Heat and Compression.

On this limestone is imposed a yellowish siliceous limestone. It is generally destitute of organic remains. It is quarried extensively for building, and is burned for quick-lime.

II. This consists of a bed of shale, two or three hundred feet in thickness. It is generally black, very fissile, and frequently, when breathed upon, exhales a fetid odor. Towards the lower part of this deposit, occur masses of carbonate of lime, of a spheroidal structure. Some of them are globes, and on being broken, exhibit no peculiar structure. Others appear to have been originally amorphous masses, traversed by calc spar and sulphate of baryta, and constitute the nuclei around which concentric layers have subsequently formed. Others, again, are lamellar in their structure. Sulphate of alumine and potash and sulphate of iron are abundant throughout this deposit. From these materials copperas might be manufactured in large quantities.

III. *Waverly Sandstone Series.*—This name has been applied to a fine-grained sandstone which is extensively quarried at Rockville, Portsmouth, Piketon, and Waverly. It constitutes the best building material in the State. This group consists of alternating layers of shale and sandstone, varying in thickness from a few inches to two or three feet. Some of this sandstone contains a large portion of aluminous matter, so that it readily exfoliates on exposure to the air. The most common organic remains in this deposit are *Encrini*, (a species of *Helix?*) besides some bivalve shells. The moulds of these remains are often filled by sulphuret of zinc and sulphate of strontian, but more frequently by sandstone. We have also noticed one or two species of *Fucoides*, probably nondescripts. Throughout the whole extent of this formation, from the Ohio river to the lake, ripple marks are found. Some of them are so surprisingly regular as to resemble the flutings of a Corinthian pillar. We have seen a surface of a hundred feet in length by fifty broad, marked in this way.

IV. *Conglomerate.*—This rock sometimes consists of an aggregation of quartzose pebbles, and again passes into a granular sandstone. It crops out on the western border of the coal measures in bold escarpments, varying from 80 to 100 feet in thickness. In a rock composed of such materials, we should not look for homogeniety of character or uniformity of thickness: for in the detritus, brought down from the primitive mountains,—of which the secondary rocks appear to have been formed,—the pebbles would have been deposited first, while the finer particles would be borne far out into the ocean. In some instances, the pebbles are deposited in layers, as though in a turbid state of the water, nothing but pebbles were deposited, while, in a more tranquil state, nothing but comminuted sand.

V. *Lower Coal Series.*—These consist of alternations of sandstones, shales, limestones, iron ores, and coals, to the thickness of 300 feet. In this belt, which extends through the State in an E. N. E. direction, are embraced the most valuable deposits. The sandstones are quarried for building, gravestones, and grindstones. The limestones are used as fluxes at the furnaces. Many of them are burned for quick-lime. One stratum, from the fineness of its texture and compactness, takes a very high polish. It can be used to advantage as a marble. Many of the shales, on disintegration form good fire-clay. But the most valuable members of this group are the coal and iron ores. There are two distinct beds of coal. The lower one is of a superior quality, and at no remote day, will be extensively mined for fuel. In reference to the extent of this deposit in Jackson and Lawrence, Mr. Briggs says:

> "The whole amount of coal between these points, from the Ohio river, north, to the Hocking valley, may be safely estimated as sufficient to form an entire stratum of fifty miles in length, five miles in width, and nine feet in thickness. This amount of coal will yield about 9,000,000 of tons per square mile. This estimate includes but a very small part of the coal, which can be obtained from the beds heretofore described; for, after disappearing beneath the water courses, they doubtless continue eastward, toward the Ohio river, sinking deeper and deeper beneath the surface, so that they can be reached only by shafts near the Ohio, at the depth of some hundred feet." p. 87.

Equal in importance are the iron ore deposits. They are rich, —some of them yielding 60 per cent.,—and easily wrought. From their juxtaposition with the coal and limestone, it requires little foresight to predict that this branch of manufacture will become a great and inexhaustible source of revenue to the State. On page 93 we have an estimate of their extent.

> "At a very low calculation of the amount of good iron ore in the region which has this season been explored, it is equal to a solid, unbroken stratum, sixty miles in length, six miles in width, and three feet in thickness. A square mile of this layer—being equivalent, in round numbers, to 3,000,000 cubic yards—when smelted, will yield as many tons of pig

iron. This number, multiplied by the number of square miles contained in the stratum, will give 1,080,000,000 tons; which, from these counties alone, will yield annually, for 2,700 years, 400,000 tons of iron—more than equal to the greatest amount in England previous to the year 1829.

"From this estimate, which it is believed is much too low, it appears that the iron ores of this portion of the state are not only sufficient to supply all domestic demands for ages, but to form an important article of commerce with other states." p. 93.

With such mineral deposits in the bosom of a State, with a soil of unsurpassed fertility, with natural and artificial channels of communication with the south and the north, with the east and the west, under the blessings of a free government, where industry is protected and labor rewarded, who can limit the prosperity of the State, or prescribe the number of her inhabitants?

Among the most interesting details of this report, are those respecting the fossil elephant discovered during the past season. As there is some doubt as to the geological position of the deposits in which these bones are found, we will extract the description.

"About two years ago, some bones, so large as to attract the attention of the inhabitants, became exposed in the bank of one of the branches of Salt creek, in the northwest part of Jackson county. They were dug out by individuals in the vicinity, from whom we obtained a tooth, a part of the lower jaw, and some ribs.

"In the examinations at this place, during the past season, it was concluded to make further explorations, not only with the hope of finding other bones, but with a view of ascertaining the situation, and the nature of the materials, in which they were found. The explorations were successful. There were found some mutilated and decayed fragments of the skull, two grinders, two patellæ, seven or eight ribs, as many vertebræ, and a tusk. Most of these are nearly perfect, except the bones of the head. The tusk, though it retained its natural shape as it lay in the ground, yet, being very frail, it was necessary to saw it into four pieces in order to remove it.

"The following are the dimensions of the tusk, taken before it was removed from the place in which it was found:—

| | |
|---|---|
| Length on the outer curve, - - - | 10 feet 9 inches. |
| " " inner curve, - - - | 8 " 9 " |
| Circumference at base, - - - | 1 foot 9 " |
| " 2 feet from base, - - | 1 " 10 " |
| " 4 " " - - | 1 " 11 " |
| " 7½ " " - - | 1 " 7½ " |

"This tusk weighed, when taken from the earth, 180 lbs. The weight of the largest tooth is 8¼ lbs.

"These bones were dug from the bank of a creek, near the water, where they were found under a superincumbent mass of stratified materials, fifteen to eighteen feet in thickness." pp. 96, 97.

The place where these bones occur is evidently a lacustrine deposit, consisting of horizontal layers of sand, loam and marly clay. The layer in which the bones occurred is dark blue, colored by phosphate of iron. The tusk in many places was tinged with this substance. This may serve as a general section of the deposits, in which these bones are found at the west, and corresponds, except in the absence of the peat, with a section given by Phillips of the lacustrine deposits of Yorkshire, in which the great Irish Elk (*Cervus giganteus*) is found. Whether these deposits belong to the newer pliocene of Lyell we are not prepared to say. We have not yet facts enough upon the subject. In Europe, the age of these deposits, can, in general, be readily recognized by the accompanying marine shells. Here so far as we have observed, there is an absence of marine as well as fresh water shells. That the bones above described, were floated to the place where they were found, is probable from their horizontal position, and the stratified deposits, with which they were covered; but not previously subjected to a considerable degree of violence, as intimated by Briggs. The jaw bone was fractured. As that was found on the surface, after a freshet, it is not unreasonable to suppose that its fracture was recent. The bones of the cranium also, were broken; this we might expect would be the case from the very frailty of their structure, without supposing that they had been subjected to violence. We see nothing in this region, which would indicate a cataclysm of sufficient power to excavate valleys, pile up deep beds of gravel, &c.; while the deposits, in which these bones were entombed, appear to have been formed in still waters. This, we infer from the horizontality of the layers, and the comminuted slate of the materials composing them. Besides, we find these bones in such a position as to induce us to believe that the carcass *might have been* drifted entire, into this lake or estuary.

The gases generated by putrefaction would cause it to rise to the surface; and as the process advanced, the bones would fall piecemeal from the floating carcass, and in that case, be scattered at random over the bottom of the lake, estuary or sea; so that a jaw would be found in one place, a rib in another, a humerus in a third—all included, perhaps in a matrix of fine materials, where there may be evidence of very slight transporting power in the current, or even of none, but simply of some chemical precipitate.*

With these remarks we take leave of the report of Mr. Briggs; we have read it with pleasure and profit.

We have described the different groups embraced in the report of Mr. Briggs. We now proceed to describe those above.

VI. *Buhr.*—This rock forms the dividing line between the upper and lower coal series. In our remarks upon Dr. Hildreth's report, we gave the principal characteristics of this rock.

VII. *Upper coal series.*—These, like the lower coal series, are composed of sandstones, shales, coal, iron ores, and limestones. The coal is the most valuable mineral in this group. There are at least, four distinct beds, capable of being wrought, and of a good quality. In this group, is included the cannel coal of Cambridge, described in a former number of this Journal. The limestones in this series, are more abundant than in the lower, and exert a beneficial influence on the soil. The Belmont Hills are noted for their productiveness. The iron ores included in this group, are not as abundant as in the lower series—nor are they wrought for manufacturing purposes. The organic remains of the two groups, do not differ essentially. In the limestones, we meet with the *Encrinite*, *Delphinula*, *Spirifer*, *Productus*, *Terebratula*, &c. We have detected no terrestrial plants. The sandstones often contain the stems of coal plants. The most common are *Stigmaria ficoides*, *Lepidodendron Sternbergi?* and several varieties of *Sigillaria*. From the shales, beautiful impressions are obtained. The principal are *Equiseta*, *Calamites*, several species of *Filices*, and *Lycopodiaceæ*, and perhaps, one or two species of *Palmæ.* Two or three species of *Astorophyllites* have been found. *Fucoides* are not uncommon.

VIII. *Tertiary deposits.*—Under this head, we place the prairies or barrens, in the western portions of the State, the pebble beds and boulders of primitive rocks, so abundant in some parts of the Scioto valley, as well as those deposits, in which the bones of extinct mammalia occur. These formations occupy an extensive area in the middle and western portion of the State.

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* 3. Lyell, Lond. Ed. 232.

IX. *Recent deposits.*—The most extensive deposits of this kind, are such as are now forming along the banks of the rivers. None of them are of sufficient interest to deserve being mentioned.

We have thus given a brief description of the principal rocks of Ohio. It is as extended as our limits would permit.

The report of Col. Whittlesey, of the topographical department, remains to be noticed. We perceive that the survey and description of the ancient works of Ohio are included in his duties. In reference to these he says:—

"I have inspected the ancient remains within the district embraced in this season's operations, and have sketches and notes of nine separate works. Further exploration and measurements are necessary, however, to render complete the plan, specification and detailed description of most of them. These plans will exhibit the figure of each ruin, as far as it can be traced upon the ground; the elevation and depression of its embankments and excavations, by means of vertical sections or profiles, and a topographical sketch of the vicinity. A plan of the remains at Marietta is nearly finished, and may serve as a specimen of the general method, according to which it is proposed to execute the whole set.

"Many of these ruins of a lost race, are to this day without a description, while their forms and dimensions are fast disappearing under the operation of the plough and the spade. For it is in the rich valleys of the Miami, the Scioto, and the Muskingum, where the modern agriculturalist now cultivates the soil, that an ancient people, more numerous than the present occupants, pursued the same peaceful avocation, at least ten centuries ago; and upon the sites of modern towns within these valleys, as at Cincinnati, Chilicothe, Circleville, Piketon, Portsmouth, and Marietta, the ancients located *their* cities, of which distinct traces exist. They also occupied many other points upon the rivers named, of which evidences remain too plain to be misunderstood. The interest manifested by the learned abroad, relative to these works, and the hasty and imperfect sketches taken of them by travellers, in addition to a local curiosity respecting our predecessors upon this soil, and the other considerations above named, seem to demand of us a thorough record of what remains to our observation. A general description will accompany the plans when complete, for which it is proper to reserve observations. But the popular name of 'fortifications,' bestowed upon these ruins, leads me to state, that I have *seen* none to which the term is applicable. I have examined the extensive works at Marietta, and those more extensive ones at, and in the vicinity of Portsmouth—at Vulgamore's, in Pike county

—at Piketon—at Kilgore's, in Ross county; and at Alderson's—with other lesser and detached works, and can discover in none of them elements of military strength, or evidences of a warlike intention. The principal enclosures are rectangles, or circles, weak figures, without ditches, made weaker by numerous openings, not only in the sides, but at the corners. The subordinate parts of large works, and the small isolated ones, *sometimes have ditches*, but always, as far as I have seen, on the *inside*, though cases of extensive fossa are said to exist. The main figure always occupies ground accessible on all sides, and no spring, or receptacle of water, is found *within the walls*. Other equally good reasons might be advanced, why these structures are not adapted, and were not designed, either for attack or defence, under any supposable mode of human warfare.

"No portion of Ohio appears to be destitute of ancient tumuli and embankments; the object and origin of which are still, in a great measure, mysterious and unknown." pp. 104, 105, 106.

We are glad that we are about to have an accurate survey, and description of these memorials of a former race. The work of Mr. Atwater, published under the auspices of the Massachusetts Antiquarian Society, is incorrect.

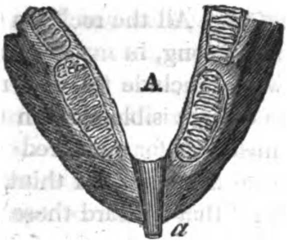
Appended to this report, is a list of geological queries, as well as a glossary of the principal geological terms, for the benefit of the general reader.

## *Remarks in addition to and explanation of the Review of the Report of the Geological Survey of Ohio*—in a letter to the Editor.

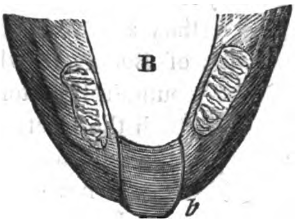
Columbus, March 23, 1838.

*Dear Sir*—You inquire whether the bones found at Jackson belonged to the mastodon or elephant? They do not belong to the mastodon, and yet they differ in some respects from the fossil elephant,) *E. primogeneus.*) These differences I will proceed to particularize. 1st. The jaws differ, as will be seen by the figures, which are not remarkably accurate, but sufficiently so for illustration.

You will perceive by the following sketch, that the jaw A converges more than B. In this respect, it approaches the existing species. There is also a remarkable difference in the construction of the canals, *a* and *b*. The tusk of the Jackson elephant is cornuform, more so than those of the existing elephant, but less so than in the fossil elephant. The *E. primogeneus* found near the Arctic ocean, had tusks, which formed nearly a circle.

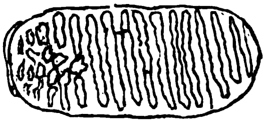


A. Lower jaw of the Elephant found at Jackson.



B. Lower jaw of the fossil Elephant.

I have not had an opportunity of comparing the teeth of this elephant with those of the *E. primogeneus.* They resemble some of those figured by Parkinson. I will give you a drawing of one of the plates of the *E. Jacksoni.* (I will so call it for the sake of brevity.) This drawing is rather too wide, in proportion to the length. Thus you will see that there are seven lines running obliquely, seven distinct ribands, and five which do not extend across the tooth. The other teeth differ from this, having more ribands which extend across the tooth, and only two which are broken. From these differences, we think that it cannot belong to the *E. primogeneus* of Cuvier, and yet we are not prepared to say that it is identical with the *E. recens.*



I agree with you, that some other designation besides Waverly ought to be applied to the fine-grained sandstone. We ought to exclude all local names. And yet the term "upper secondary" is objectionable, since this rock underlies all the coal, and is separated from the carboniferous limestone only by a bed of shale, three hundred feet thick. The term Waverly is used to designate a peculiar member of the secondary rocks, a particular stratum which I have never seen elsewhere. It is composed of comminuted sand, and yet it adheres so closely as to form the best building material we have in the State. It is a rock *sui generis.*

Dr. Hildreth, I suspect, must have arrived at the conclusion that the new red sandstone was found in Ohio, merely from the lithological characters of some of the rocks. The sandstones are occasionally tinged red, but this is local. For example, the conglomerate, beneath *all* the coal, sometimes assumes this appearance, and the Doctor was disposed to call it the new red sandstone, merely from its external characters. All the rocks in Ohio, except the tertiary and recent deposits, belong, in my opinion, to the transition of Buckland, which would include the coal measures and the mountain limestone, the oldest visible rock in Ohio. Those rocks which the Doctor has mistaken for new red sandstone belong to the sandstone of the coal measures. I think I remark in my review, (I have not a copy,) that I regard those rocks in the eastern part of the State, as the most recent, aside from the superficial deposits, since the dip is E. S. E., and unbroken. At Wheeling, two beds of coal crop out, which extend into Ohio. For these reasons, I think that neither the new red sandstone, nor the lias, nor the oolite, is to be found in Ohio. I was desirous to discuss this point, as the impression has gone abroad, that the new red sandstone is found here.

## ART. XI.—*Researches in Magnetic Electricity and new Magnetic Electrical Instruments;* by CHARLES G. PAGE, M. D.

1. *Compound Electro-Magnets for the Magnetic Electrical spark, shock and decomposition.*—In the last number of this Journal, I announced this new form of magnet, as decidedly superior to the common solid electro-magnet, for exhibiting magnetic electrical phenomena. I have since performed a variety of experiments, with reference to the best mode of constructing these magnets, and arrived at some beautiful results and important conclusions. I find that the magnet made of flat plates of thin hoop iron, answers best for lifting power and sparks; but those made of fine annealed iron wire, answer nearly as well, and (for reasons, by and by to be mentioned) will in some cases be found preferable to the flat bars. Sixteen magnets were made of soft iron wire, in bundles of various lengths and diameters. Thirteen were made of No. 26 wire, two of No. 16, and one of No. 8. For lengths within ten inches and diameters within one inch, the very fine wires answer best. But for longer and larger magnets than these, the larger iron wires answer equally well. Each of these magnets were tried with one, two, and three coils of No. 16, copper wire, (wound each the whole length of the bars and superposed by a single

pair of lead* and zinc plates, eight inches single surface of zinc,) kept constantly in good action by the sulphate of copper. One of these magnets weighing two ounces, with four coils of fine wire exterior to three of large, gave a shock which could not be endured. The two best magnets of the sixteen, were, one made of one hundred fine wires six inches long, and one of five hundred wires, ten inches long. This last, furnished the most splendid deflagrations, and by far the strongest shocks. Its decomposing power was very great, for the means used. One was prepared of one thousand wires, and a foot long, but its power was inferior to that of five hundred wires. This large compound bar was ultimately sawed in halves, and each half indicated as much power as the whole. This fact seems to prove, that the length of the coils of copper wire, was too great for the size. I apprehend that a copper wire of a larger size,† would have made it superior to the other magnets. The advantage before alluded to, possessed by the magnets prepared from bundles of fine wire, is, the facility of making a curved or U magnet,‡ wound accurately throughout its length. There is little or no advantage in winding common magnets on the curved portion, owing to the difficulty of laying the wire on that part, at right angles to the axis of the bar. A very perfect U magnet covered accurately throughout its length, is readily made, by winding a straight bundle of fine iron wire, with as many coils of copper wire as desired, and bending them afterward, They are bent with ease, and the wire disposes itself on the bent portion in a beautiful and regular manner. All the magnets that were made of this description, were tried before and after they were bent, and no change in their properties could be observed. The best of the magnets, above alluded to, was covered with two hundred feet of fine wire, exterior to four coils of large wire. Combining the secondary currents of the large and small wire, the shock was so great as to render it difficult to keep even the tips of the fingers upon the wires. A single thermo-electric pair, heated and cooled, connected with the large wire, gave a bright spark and a shock, which could be felt as far as the wrist. The use of three pairs in sequence, enhanced the results. It must here be observed, that the shocks and sparks, are not thermo-electric, but magneto-electric. The pure thermo-electric spark, I apprehend, has never yet been seen. I obtained, a long time since, sparks and shocks from a thermo-electric pair, in connexion with Henry's flat spiral. But in that case also, the results were purely secondary, or magneto-electric, the copper spiral while transmitting a current, in fact, representing a magnet with axial poles. I have always maintained the position, that a shock direct, cannot be obtained from a single pair of plates, or any elementary current, under any arrangement whatever. Although recently, we have the high authority of Faraday, that iodide of potassium, and some other compounds may be decomposed, by a single galvanic pair, yet even admitting this to be fully established, I see no reason for retracting, and may continue safely to assert, that an elementary battery however large, cannot afford a direct appreciable shock. In Faraday's experiment, the decomposition was the result of uninterrupted action, but in all experiments hitherto, where shocks have been obtained by the aid of a single pair, they have been obtained as single impulses, immediately consequent to the completion of the circuit, as with the large magnet of Prof. Callan, or as in all other cases, to the interruption of the circuit. In a new instrument, shortly to be described, I have a singular instance of an electro-magnet, affording shocks, not only on the completion and breaking of the circuit, but even while the battery current is passing without interruption. It appears irrational to suppose for a moment, that the shock obtained by breaking the circuit with coiled conductors, can receive any augmentation from the conjunction of the primitive and secondary currents, for the presumption is, and the fact itself seems sufficiently obvious, that the sparks and shocks indicating a new and secondary current are directly consequences of the dissolution of the primitive current. In other words, the effects produced by the breaking of a primitive elementary current, are due solely to magnetic excitation, and have no connexion with that primitive, except that of cause and effect. In fact, strictly speaking, the results thus observed are not secondary, but tertiary phenomena; the secondary production, being the development or neutralization of magnetic forces. And, as Mr. Sturgeon has very ably set forth in his beautiful theory of electro-magnetic lines, in the present state of our knowledge, it is indispensable to the explication of the reciprocal action of magnetism and electricity, to *suppose* the existence of a secondary intervening medium, whether the coiled conductors act with or without the co-operation of ferruginous bodies. One singular fact which I noticed, nearly two years since, remains to be reconciled with the postulates, that a direct shock cannot be appreciated from an elementary current, and that secondaries are strictly consequences remote from primitives. When two, three or four pairs of plates, or any number below twelve, arranged as a compound series, are connected with coiled conductors, with or without soft iron enclosed, the sparks and deflagrations, are far more brilliant on breaking the circuit, than with the same plates used as a simple or elementary battery. This fact is readily accounted for. The battery current itself is capable of passing through perceptible space, with appreciable duration, and as the secondary current, (which is the natural electricity of the wire, set in motion by magnetic forces,) returns to its equibrium through the medium of the battery plates and its liquid, the two currents must here move in conjunction, and enhance the combustion of the metals used. I have strictly examined the power of the pure secondary developed in this way, and find it never to exceed the secondary from the same pairs arranged as an elementary series. In fact, the secondary begins to diminish, just when the magnetizing power of the compound battery begins to diminish, which is well known to occur, as the series extends. The properties of small and large compound batteries, have moreover been examined while the currents have been passing through circuits from twenty feet to half a mile, without any observable characteristic changes. But to return to the action of the compound electro-magnet. The superior value of these magnets, whether made of flat plates, or fine wire, may be traced to several causes. First, the homogeneous texture of the iron from which wires or flat plates are made, is favorable to the extensive development of magnetism. Secondly, the same quality favors its neutralization, when the exciting cause is withdrawn. Thirdly, the sum of the actions of so many highly charged magnets, and lastly, the mutual neutralizing influence of the individual magnets of a similar polar arrangement. This last, is by far the most important consideration. The following experiments, throwing light on this point, will be regarded as novel, and have an important bearing on the subject of magnetism itself.

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* If properly prepared, lead for the negative plate, is much superior to copper, where the sulphate of copper is used.

† I have universally found that large wire answers best for large magnets, and small wire for small magnets. The larger the wire, the more freely it conducts, but large wire cannot be used with advantage on small magnets, as the coils or turns will not be sufficient in number, and the axis of the wire will lie more oblique to the axis of the magnet, than that of a smaller wire, or than upon a larger magnet.

‡ The term, horse shoe, applied to magnets, is inappropriate, and has led many into the error of constructing magnets of this awkward and disadvantageous form. The letter U would briefly designate this species of magnet.

Take a piece of fine iron wire, carefully annealed, three or four inches in length, and touch it once with a common steel magnet. Being very soft, it yields readily to the inductive influence, and as its length is very great, compared with its breadth, if carefully handled, it will be found to retain sufficient power to hold more than its own weight. Hold it now by one end and snap the other with thumb and finger, and its magnetism will be instantly lost. The same quality of the iron which favored the extensive development of magnetism, favored also its neutralization on the disturbance of molecular forces. The transition here was so sudden and decided, that I was led to try the influence of a magnet thus operated upon, in developing electricity. A long piece of iron wire, retaining considerable magnetic power, was suspended so as to vibrate freely in a spiral of copper wire. A smart rap upon the suspended iron wire, determined a strong galvanic current through the copper spiral, as indicated by the galvanometer. The result, though readily anticipated, was nevertheless very striking. Again, take a number of pieces of fine iron wire, and magnetize them separately, so that each by itself will hold its own weight; combine them now in a bundle, and instead of the aggregate lifting power of the elements, you scarcely realize the power of one of those elements, owing to the neutralizing influence of the similar poles. It is the co-operating, neutralizing effort of similar poles, that chiefly determines the superior value of the compound electro-magnet for magnetic electrical experiments. The fact that very fine steel wires answer almost as well for these magnets as wires of soft iron, strongly corroborates this last position. For the knowledge of this curious fact I am indebted to Mr. Daniel Davis, philosophical instrument maker, of Boston. A bundle of fine steel wires when wound, give a bright spark and strong shock, whereas the same amount of steel in a solid bar, produces a hardly perceptible augmentation.

2. *New Magnetic Electrical Machine, or Magneto-Electric Multiplier, convertible into an Electro-Magnetic Engine.*—In order that this machine may be readily comprehended, it will be

necessary to make a few brief preliminary observations, and to advert to the discoveries which led to its invention. When a piece of soft iron enclosed in a helix of wire, is rendered a magnet, by the approach of a magnetized bar, a current of electricity flows through the helix (during the *development* of magnetism) in a direction contrary to that of a galvanic current, which would render the piece of soft iron a magnet of the same character. Withdraw the inducing magnet, and during its withdrawal, or the neutralizing process in the piece of soft iron, the direction of the electric current in the helix will be the *same* as that of a galvanic current which would render the soft iron a magnet of similar polar arrangement. Similar momentary currents are excited when the exciting cause is a galvanic current. *Completing* the galvanic circuit with the helix, determines a current flowing against the battery current. *Breaking the circuit*, determines a current flowing in the same direction with the battery current, which produces the bright spark. Any disturbance of magnetic forces is accompanied with a disturbance of electric equilibrium. It is well known, that an electro-magnet possessing an immense lifting power when its poles are joined by an armature, exerts a comparatively feeble action at a distance. The reason is this: the two magnetic forces or poles are tending constantly to neutralize or disguise each other, the softness of the iron favors this mutual action, and the whole amount of magnetism developed cannot be perceived, until the magnetic forces are insulated or determined towards the poles by the application of an armature. The application then of the armature must occasion a considerable disturbance or movement of magnetic forces, and give rise to an electrical current in the wires. The direction of this current can easily be predicted, from what has been before said. The application of the armature is equivalent to the further development or separation of magnetic forces: hence the new current will flow against the battery current. When the armature is pulled off, the new current is in the same direction as that of the battery. And if the magnet-wires be so arranged that the galvanic circuit may be broken at the instant of pulling off the armature, it will be found that the magneto-electric spark and shock will be far greater, than can be obtained by simply breaking the circuit, without the aid of this operation. Thus we have a new method of augmenting to a great degree the magneto-electric currents from an electro-magnet. The application of the armature contributes to the development of magnetism, and on the simultaneous withdrawal of the armature, and the galvanic current, the whole amount is suddenly neutralized.* The current developed by the *application* of the armature, I have appreciated by the following experiments, and I find its consideration to be of very great importance in the application of electro-magnetism as a moving power. This subject will be considered at some future time, and at present I shall be content with giving briefly the reasons why we cannot increase the power with economy, where a great number of magnets are charged by the same battery. 1. The motion of attracting poles towards each other, actually diminishes the power of each magnet, by determining a current against the current of the battery. 2. The succession of similar or repelling poles, determines a current also against that of the battery. 3. The withdrawal of attracting poles (which must be effected by mechanical power, and is of course directly against an independent movement,) maintains the power of the magnets, as the new current is then in favor of the battery current.

*Exp.*—To test the value of these secondary currents, I included a galvanoscope in the circuit with an electro-magnet, and placed the needle beyond the direct influence of the magnet. On bringing up the armature, the needle returned four degrees, and on suddenly applying it, the needle swung nearly back, but immediately returned to nearly its original deflection of 40°. Suddenly pulling off the armature, the needle swung over 90°. The following experiment is still more striking. Connect two electro-magnets, so that they shall be charged in sequence, but at the same time, and with the same battery. Load one of them with about as much as it will hold. Apply the armature to the other magnet, and the weight of the first magnet will immediately drop. The same may be repeated with either magnet. The power of this reacting current, as it may be called, is in proportion to the number of magnets in use, charged by the same battery, the number of coils of wire covering the magnets, and lastly in proportion to the rapidity of motion.

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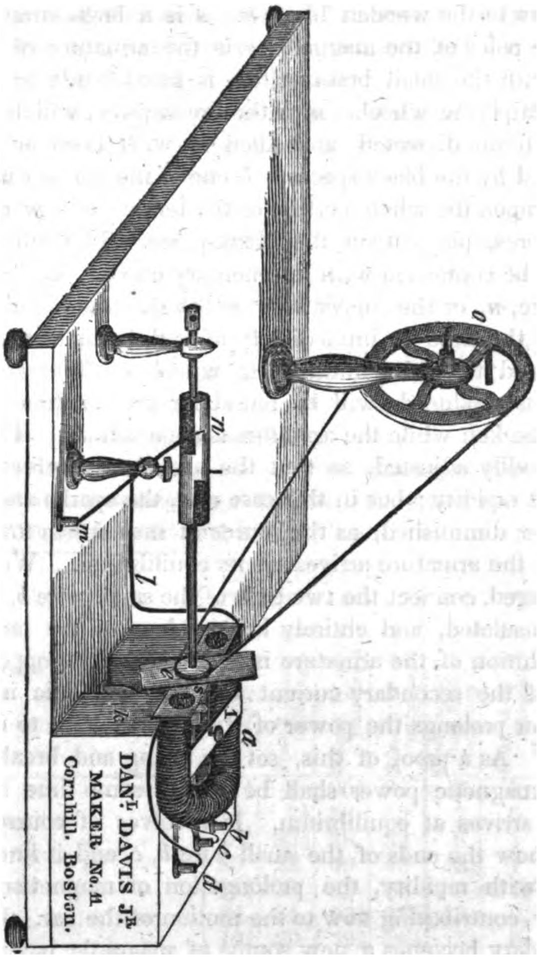
* A steel magnet gains power slowly when its poles are armed and loaded simply by determination, or insulation of its poles. Pulling off the armature again weakens its power. Jerking it suddenly off, weakens it still further. In this case the magnetic forces seem to acquire momentum, and go beyond their original statical development.



The operation of the magneto-electric multiplier will now be understood at a glance. It is simply an electro-magnet, with a revolving armature and break-piece. The revolution of the armature is of course equivalent in its effect, or nearly so, to its rectilinear approach and abduction. *a* is a small compound electro-magnet, 12 inches in length before bent, composed of 500 fine iron wires, covered with 5 superposed coils of large copper wire, No. 16, and 7 layers of fine copper wire, No. 26. *b*, *c*, are the terminations of the small wire, *d*, *l*, the terminations of the large wires. 1, is a wooden strap, which, with a binding-screw, secures the magnet to the wooden block *k*. *s* is a brass strap, to hold firmly the poles of the magnet. *e* is the armature of soft iron, which, with the small brass pulley, is fitted firmly to the shaft. *o*, the multiplying wheel. *n*, is the break-piece, which is merely a copper ferule dissected, and filled up with wood or ivory, as represented by the black spaces. *l*, one of the magnet wires bent up, plays upon the whole portion of the ferule; and *m*, one of the battery wires, plays upon the break-piece. The other battery wire is to be connected with the mercury cup *d*. Adjust now the break-piece, *n*, or the copper wire, *m*, so that the circuit shall be broken at the time or immediately after the armature leaves the magnet, and turn the multiplying wheel *o*. The sparks and shocks thus produced, will be found far greater than when the circuit is broken while the armature is approaching. The break-piece is readily adjusted, so that the armature revolves of itself with great rapidity; but in this case also, the sparks and shocks* are at once diminished, as the source of magnetism must be cut off before the armature arrives at its equilibrium. With things thus arranged, connect the two ends of the small wire *b*, *c*. (This wire is insulated, and entirely independent of the large wire.) The revolution of the armature is now suddenly stopped. The flowing of the secondary current after the galvanic is broken, keeps up or prolongs the power of the magnet so as to retain the armature. As a proof of this, set the spring and break-piece so that the magnetic power shall be cut off, some time before the armature arrives at equilibrium. It revolves of course slowly. Connect now the ends of the small wire *b*, *c*, and it immediately revolves with rapidity, the prolongation of magnetism by the secondary, contributing now to the motion of the bar. Here then the secondary becomes a new source of magnetic power. This instrument, when the armature is revolved mechanically, affords a shock from *b*, *c*, both when the circuit is completed and broken. The sparks are exceedingly brilliant, and the shocks so powerful that they are sometimes felt by the bystanders through the floor. The light from charcoal points is intense. It decomposes pure water, and charges the Leyden jar. But its most remarkable and novel property is that of giving a slight shock without breaking the circuit, and while the galvanic current is flowing without obstruction. To effect this, place the spring-wire *m*, with *l*, on the whole portion of the ferule and turn the wheel. A slight shock will be felt at *b*, *c*, being simply the consequence of magnetic disturbance by the motion of the armature. A single thermo-electric pair of bismuth and antimony plates heated and cooled, affords a shock which is felt as far as the wrist.

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* The shocks are taken from the cups *b*, *c*.

Washington, D. C. June 2, 1838.

## MISCELLANIES.

1. *Synopsis of a Meteorological Journal kept in the city of New York for the year 1837, including the average results of the last five years;* by W. C. Redfield.—The observations which I have made on the direction of the wind near the earth's surface, and also on the direction of the highest observed clouds, at periods of four hours' duration, commencing at 6 A. M. and ending at 10 P. M., are comprised in the following table.*

| Monthly results for the year 1837. | Direction of the wind at the surface, in periods of four hours each. | | | | Direction of the highest observed current in the region of clouds. | | | |
|---|---|---|---|---|---|---|---|---|
| | Observations of wind from N. E. quarter, including N. | From S. E. quarter, including E. | From S. W. quarter, including S. | From N. W. quarter, including W. | Observations of clouds from N. E. quarter, including N. | From S. E. quarter, including E. | From S. W. quarter, including S. | From N. W. quarter, including W. |
| January, - - - | 21½ | 1 | 35½ | 85 | 3 | 0 | 51 | 78 |
| February, - - | 14 | 7½ | 56 | 53 | 7 | 0 | 66 | 27 |
| March, - - - | 48½ | 32½ | 38 | 32 | 8 | 1 | 62 | 43 |
| April, - - - | 35 | 22 | 49 | 43 | 5½ | 1 | 49½ | 49 |
| May, - - - | 21½ | 58 | 33 | 34 | 5 | 11½ | 77 | 34½ |
| June, - - - | 24 | 34 | 73½ | 13½ | 13 | 0½ | 44 | 23½ |
| July, - - - | 10½ | 20 | 79½ | 29½ | 3½ | 6 | 51 | 55½ |
| August, - - - | 18½ | 36 | 48½ | 44 | 0 | 0 | 48 | 20 |
| September, - - | 33 | 28 | 43 | 35 | 11 | 5 | 67 | 27 |
| October, - - - | 45½ | 15½ | 43½ | 41½ | 4 | 8 | 72½ | 32½ |
| November, - - | 6 | 13 | 72½ | 51½ | 0 | 0 | 40 | 54 |
| December, - - | 32½ | 1½ | 58½ | 61 | 0 | 0 | 51 | 62 |
| Number of observations, | 310½ | 269 | 630½ | 523 | 60 | 33 | 679 | 506 |
| Proportion in 1000, | 179 | 155 | 364 | 302 | 47 | 26 | 531 | 396 |
| Average proportion in 1000 for 5 yrs., | 219 | 127 | 388 | 266 | 55 | 21 | 593 | 331 |

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* For a summary of observations from 1833 to 1836 inclusive, see Reports of the Regents of the University of the State of New York for the years 1835 and 1837; also, American Journal of Science, Vol. xxviii, pp. 154—159.

Average proportion of easterly winds in 1000 for five years, 346
Do. of westerly winds " for same period, 654
The westerly surface winds being to the easterly *nearly as two to one.*
Proportion of E. winds in the region of clouds, for five years, 76
Do. of W. winds, " " for same period, 924
The westerly winds being to the easterly, in the region of clouds, during this period, in the proportion of *nearly twelve to one.*

From the foregoing synopsis of observations it appears that the main current of atmosphere prevailing in this region is from the southwestern or western quarter. This may account for the general uniformity of the course pursued by our storms, of almost every description.

*Table of the monthly mean height of the barometer in English inches, for each of the five daily observations recorded during the year* 1837; *with the average results of the last five years,* 1837 *included.*

| 1837. | Mean of barometer at 6 A. M. | At 10 A. M. | At 2 P. M. | At 6 P. M. | At 10 P. M. | Monthly mean. |
|---|---|---|---|---|---|---|
| January, . . . . . . | 29.855 | 29.908 | 29.854 | 29.874 | 29.890 | 29.876 |
| February, . . . . . . | 30.022 | 30.039 | 30.014 | 30.021 | 30.035 | 30.026 |
| March, . . . . . . . | 30.210 | 30.245 | 30.210 | 30.199 | 30.225 | 30.218 |
| April, . . . . . . . | 29.924 | 29.949 | 29.895 | 29.907 | 29.960 | 29.927 |
| May, . . . . . . . | 30.035 | 30.075 | 30.041 | 30.032 | 30.058 | 30.048 |
| June, . . . . . . . | 29.950 | 29.960 | 29.950 | 29.931 | 29.951 | 29.948 |
| July, . . . . . . . | 30.011 | 30.027 | 30.002 | 29.985 | 30.005 | 30.006 |
| August, . . . . . . . | 30.086 | 30.094 | 30.075 | 30.068 | 30.087 | 30.082 |
| September, . . . . . | 30.262 | 30.282 | 30.243 | 30.234 | 30.256 | 30.255 |
| October, . . . . . . | 30.259 | 30.272 | 30.239 | 30.281 | 30.273 | 30.265 |
| November, . . . . . . | 30.160 | 30.193 | 30.156 | 30.168 | 30.189 | 30.173 |
| December, . . . . . . | 30.167 | 30.193 | 30.144 | 30.181 | 30.214 | 30.180 |
| Average results, . . . | 30.087 | 30.103 | 30.069 | 30.073 | 30.095 | 30.085 |
| " " for five years, | 30.097 | 30.118 | 30.086 | 30.083 | 30.105 | 30.098 |

In the foregoing table no correction is made for temperature or for variation in the surface level of the cistern. The annual mean of the attached thermometer is near 68° Fahr., and the capacity of the tube to that of the cistern as one to forty. The capillarity of the tube is provided for in the zero adjustment of the instrument, and its position is about ten feet above the ordinary sea level.

*A Table showing the Monthly Maximum and Minimum of the Barometer at New York for the year* 1837.

| 1837. | Monthly maximum and date. | Monthly minimum and date. | Monthly range. |
|---|---|---|---|
| January, . . | 30.37 on the 13th, wind N. N. W. fair. | 28.83 on the 21st, gale N. E. by E. | 1.54 |
| February, . . | 30.57 on the 13th, close of gale at N. W. | 29.27 on the 23d, change of easterly storm. | 1.30 |
| March, . . | 30.57 on the 2d and 11th, fair N. N. E. | 29.63 on the 18th, change of southerly storm. | .94 |
| April, . . | 30.40 on the 28th, wind S. S. W. clear. | 29.12 on the 8th, change of easterly storm. | 1.28 |
| May, . . | 30.40 on the 2d, wind S. W. fair. | 29.63 on the 6th, change of S. E. storm. | .77 |
| June, . . | 30.20 on the 29th, wind S. W. fair. | 29.60 on the 7th and 20th, do. do. | .60 |
| July, . . | 30.35 on the 17th, wind S. W. fair. | 29.74 on the 24th, change of southerly storm. | .61 |
| August, . . | 30.49 on the 6th, wind W. fair. | 29.70 on the 30th, do. do. | .79 |
| September, . | 30.67 on the 24th, wind N. clear. | 29.83 on the 11th, do. do. | .84 |
| October, . . | 30.73 on the 9th, w'd N. E. fair: gale off the coast. | 29.87 on the 20th, do. do. | .86 |
| November, . | 30.70 on the 28th, wind N. E. fair. | 29.18 on the 22d, change of S. E. storm. | 1.52 |
| December, . | 30.63 on the 23d, wind W. S. W. | 28.98 on the 18th, do. do. | 1.65 |
| Annual results, | 30.73 October 9th. | 28.83 January 21st. | 1.90 |
| Do. corrected for var. in level of cistern $\frac{1}{10}$. | 30.75 | 28.81 | 1.94 |

The irregular fluctuations of the barometer during the year 1837, have been somewhat remarkable. For the first ten days in January, which included alternations of stormy weather, the mean height of the barometer was only 29.68 inches. The mean of the first ten days in March was 30.47 inches, this too being a period of variable weather, with heavy gales on the Atlantic, passing near our coast. From the 18th of September to the 18th of October, an entire month, the mean of the barometer was 30.32 inches, the mercurial column having but once in this period fallen to 30 inches for a single observation, although several violent storms traversed the southern coasts of the United States, and over the north Atlantic during this time, on routes not greatly distant from this part of our coast. Other periods during the summer and autumn were distinguished by similar results. This may show that, while the barometer is known to fall when under the action of these storms, a contrary effect is produced upon the exterior border of the storm, a fact which might be inferred from the known rotative character of these gales.

New York, February, 1838.

2. *Notice of a Bramah Press attached to the eyes of certain fishes;* by Dr. W. C. Wallace, Oculist, New York.—When tracing the nerve which supplies the muscle of the crystalline lens in the halibut, I noticed at the bottom of the socket, an aperture communicating with a passage of some extent, and intersected by numerous bands. As I had often before observed an effusion of water when cutting out the eyes of this animal, I procured another head and injected water into the socket: the eyes were immediately elevated, and the field of vision enlarged. This provision for projecting the eyes according to the wants of the animal, and for withdrawing them in case of danger, explains the necessity for a thick coat of jelly, or of fat behind the retina, to keep the fine filaments of the nerve at a proper temperature.

The socket of the turtle contains cavities, into which air may be forced, and the eye blown out. The air cavities are intersected by numerous tendons and fleshy columns, to keep the eye from being pushed out too far. By this contrivance, the eye may be sunk so far in the socket, that there is no danger of striking the organ against the shell, as the head advances or recedes.

3. *Maynard's Catalogue of Mathematical and Philosophical books.*—A very extensive catalogue of mathematical and philosophical books, has been lately published by Mr. Samuel Maynard, of London. The books are offered at reasonable prices, and among them are many that are rare and valuable. Mr. Maynard confines himself to the sale

of works on the mathematical sciences, and accordingly, endeavors to have, as nearly as may be, a complete collection of such works. Those who have occasion to purchase mathematical and philosophical books, might, we think, apply to him with much advantage. His address is, Mr. Samuel Maynard, No. 8, Earl's Court, Leicester Square, London.

## 4. *New Trilobites.*

### (1.) CERATOCEPHALA GONIATA.*

Communicated to the Western Academy of Natural Science at Cincinnati, May 25th, 1838; by JOHN A. WARDER.

### *Genus*, CERATOCEPHALA.

So named because the head is ornamented with appendages which so nearly resemble the antennæ of recent crustaceans, that this genus which we have ventured to propose, seems to form the link that was deficient between extinct and existing forms, and to confirm the generally entertained belief, that the trilobite race were true analogues of the crustacea. This genus embraces two species already found, one at Springfield last summer, the other near this city, by J. G. Anthony, on the first of April.

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* PROF. SILLIMAN—*Dear Sir*—I am desirous to make use of your valuable Journal to publish an account of a new trilobite which has been recently discovered. It differs so entirely from the genera that we find described, and is yet so clearly a member of the race, that the erection of a new genus appears necessary, although the proposition is made with diffidence, by one who objects to the confusion which is apt to grow out of needless distinctions, and too great subdivisions of natural families. Although it is generally admitted that they are evidently analogous to the crab, it has been often and strenuously denied that trilobites possessed any organs corresponding to their *antennæ*. We are now prepared to offer conclusive testimony to the contrary. The specimen, of which we send you a drawing, was found at Springfield, Clark county, Ohio, in the same locality with the Calymene Blumenbachii, bufo? phlyctanoides, and other rare fossils—(all the remains found in that rock are casts of the inner or under side of the crustaceous covering)—the one under consideration I procured last week from the cabinet of Mary A. Warder.

Two specimens of another species have been found near this city by J. G. Anthony, on the first of April, presented to the Academy for examination on the fourteenth, and reported on at our meeting of the thirtieth, at which time it was admitted to belong to some unknown genus of trilobites, bearing horns or feelers; but the committee to whom it was referred hesitated in describing it, because they were in hopes that some further elucidation would be furnished by new and more perfect specimens. In the mean time, J. G. Anthony wrote letters and sent casts to Prof. Jacob Green, and to the Academy of Sciences in Philadelphia, to Dr. De Kay of the New York Lyceum, and to Dr. Storer of Boston—so as to disseminate the information as much as possible, and by this means to secure the priority—so that if any of these gentlemen have ventured to erect a new genus from the fragment, I shall be willing to have my species merged in their genus, provided, the characters will embrace it, as my generic characters do his; but as I can hardly imagine they have taken any steps in the matter, and as my specimen was first found and had excited the attention of its possessor, the following paper was prepared and read before our Academy on the evening of the 24th instant, at nine o'clock, P. M. Yours, respectfully, J. A. W.

*Generic characters.*

*Body*, contractile?

*Head*, full, lobate, irregular, tuberculated, and furnished with two antennæ or horns, projecting forward beyond the buckler, based between the termination of the front and the margin of the lip; between them there is a central eminence on the mesial line.

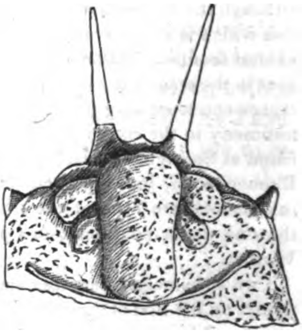
*Front*, prominent.

*Cheeks*, extending on each side so as to form large spherical triangles, separated from the front by deep sulci, in which are placed oculiform processes, (three in number?)

*Abdomen and tail*, deficient in our specimens.

*Species*, CERATOCEPHALA GONIATA.

Clypeo antice angulare, convexo, punctato; tuberculis oculiformibus eminentissimis et triplicibus; cornibus prorsum expansibus.



The head of this species presents the outward figure of half an irregular decagon, full, nearly semi-cylindrical in its transverse diameter, furnished with two antennæ projecting forward; they originate between the front and lip, nearly opposite the sulcus, between the front and cheeks; they are broad at the base, and extend two lines to the place where they are broken off: between these and the front there is a raised point half a line high, on the mesial line, covered with tubercles precisely like those of the *Calymene Phlyctanoides.* Lip raised, and semi-circular anteriorly, but extended laterally by angular projections from the cheek. Three oculiform processes occupy the spaces between the front and cheeks; the upper and lower pairs most prominent, and have deep pits beside them. Front, prominent. Cheeks, extending on each side so as to form large irregular triangles, are ornamented laterally by a projection, supporting the angles of the lip, giving the whole buckler its very irregular form. Near the centre of each cheek there is a prominence half a line high, apparently broken off; these are connected by a raised line sweeping back around the posterior extremity of the *front.*

Abdomen and tail wanting in our specimen, believed to be tubercular throughout—(as a fragment presents that appearance.)

Breadth of the head one inch and a quarter; length three quarters of an inch.

## (2.) CERATOCEPHALA CERALEPTA.

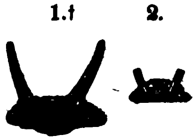
Communicated to the Western Academy of Natural Science at Cincinnati, April 14th, 1838, by JOHN G. ANTHONY.

*Ceratocephala ceralepta.*—Clypeo antice rotundato, subplano, granulato.

Margine crenulata.

Cornibus prorsum expansibus et gracilibus.[*]

The buckler is semi-lunate, surface covered with fine granulations resembling shagreen; its margin is raised, presenting a rounded rim, over which pass two antennæ, distant from each other where they pass over, about one fourth of an inch. These antennæ extend one third of an inch beyond the rim, and are only one third of a line in diameter, forming a character from which we derive our specific name, "ceralepta" (slender horned); their extremities are broken off, and it would appear that they have been several lines longer; they diverge a little at their extremity, being about one line more distant there than at the margin of the buckler; they are inserted about one line within the rim. Between the horns there is a triangular process extending from the rim back as far as their insertion; this has two deep sulci on each side, separating it from the antennæ. No abdomen or tail has yet been found, which could be identified as belonging to this species.



Only two specimens are known to have been found, both by myself. They were discovered among the rubbish thrown down from a quarry, half a mile from this place. Millions of fragments may be found there of Calymenes, Isoteli, &c., and we may hope a more perfect specimen of our own species.

When first shown to some scientific friends, it was pronounced a part of Ceraurus pleurexanthemus, and Dr. J. Green so judged it from an imperfect cast shown him. Those who have since had an opportunity of comparing my specimen with a Ceraurus pleurexanthemus found in this vicinity this spring, have discovered that it cannot be confounded with it. Among those who thus doubted at first, and afterwards became convinced, I may mention Dr. J. A. Warder of this place, who, on a recent visit to Springfield, Ohio, found among some fossils belonging to his sister, a specimen of what he deems another species belonging to the same genus with the present. On consultation, we have concluded to form a new genus, to be called Ceratocephala, (*horned head.*)

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[*] Cabinet of John G. Anthony.

[†] 1. Under side of the head of Ceratocephala ceralepta.—2. Upper view of another specimen. The color of the fossil is a dark brown, nearly black

### (3.) ASAPHUS POLYPLEURUS. *Green.**

*Clypeo? costis abdominis duplicibus; cauda rotunda; corpore convexo.*

This Asaph, at first sight, seems to differ especially from all the other American species hitherto noticed, in the number and thinness of the ribs, or costal arches of the abdominal lobes. When carefully examined, however, it becomes obvious that the apparent number of the ribs is produced by a straight longitudinal furrow on the upper surface, which divides each rib into two nearly equal portions, thus seemingly doubling their number. These furrows or grooves do not terminate in the costal arches, but extend, in several instances at least, beyond, into the *membranaceous expansion* by which they are surrounded. The ribs therefore do not end in free angular points, as those of the A. Wetherilli, the A. Limulurus, and some others. The membranaceous expansion forms a narrow semicircular border round the lateral and caudal edges of the body. The middle lobe of the back is very prominent. The animal is decapitated, and the fragment described measures in length and breadth three fourths of an inch.

The above trilobite occurs in a coarse grained greyish limestone, which contains other fossils. It was found by that distinguished geologist, Richard C. Taylor, Esq., in the state of Missouri, on the bank of the Mississippi, near the mouth of the Des Moins river. It is to be regretted that our fossil is so much mutilated and worn; but enough yet remains to identify from it the species, when perfect specimens shall be discovered. The prominence of the middle lobe of the abdomen indicates that it may ultimately be referred to some other genus than the Asaph.

### (4.) *Additional notices of Trilobites.*

From Mr. J. Walter, of Louisville, Ky., we have received a drawing of a trilobite seven and a quarter inches long, by four inches broad.

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* Communicated for this Journal, by JACOB GREEN, M. D. Professor of Chemistry in the Jefferson Medical College, Philadelphia.

Specimens we have not seen, but the drawing has been inspected by a gentleman, than whom there is no better authority; and although he wisely declines to give a decided opinion upon a drawing merely, it appears probable, that this is a new species; but we decline inserting either the drawing or descriptive notices, until a specimen can be examined. This fossil is found in Bourbon county, Ky.; and about thirty miles from that place, in Mason county, there is found a very perfect trilobite, two and three quarter inches by one and a quarter. Mr. Walter will confer a favor by sending specimens to Prof. Jacob Green, Philadelphia, and to the Editor.

A letter from Mr. Willis Gaylord, dated Otisco, Onondago county, N. Y., June, 1838, contains drawings of very perfect orthoceratites and trilobites, which are known to prevail very extensively in that region. We believe the species not to be new; and if they are new, they have probably not escaped the attention of the gentlemen engaged in the geological survey of the state of New York.

5. *Substitute for Emery.*—Topaz, the discovery of which in this country was first announced in this Journal* many years since, has continued to occur in such abundance, (although not *in general* beautiful,) that the owner of the locality has been induced to crush it to powder as a substitute for emery. The hardness of the topaz is such (8) as to place it next to corundum, (9) with the exception of spinelle, automolite and chrysoberyl, which approach nearer to corundum than topaz; but they have never been found in the quantity that the latter occurs at Monroe. And we understand that those who have made use of this substitute find, that for all common purposes, it answers very well.

6. *Temperature of the Saco River.*—I send for publication in the Journal of Science, a table of observations made during the past year upon the temperature of the Saco river. The experiments were made in running water, above the falls, and may be relied upon as correct.

This river has its source in the 'Notch' of the White mountains of New Hampshire; is about ninety miles in length, and falls into the ocean three miles below the place where the observations were made.

It will be noticed, that during the time that the river was covered with ice, the water remained stationary at the freezing point. On the 9th of December, at six o'clock, A. M., about three fourths of the water was stopped by anchor ice. The day was clear, and the warmth of the sun having removed the ice, the water flowed in the usual quantity at about ten o'clock.

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* Vol. x. p. 352. Vol. xi. p. 192, &c.

The river was clear of ice on the 10th day of April, and closed on the 9th of December, being the day on which the anchor ice referred to was formed, the temperature changing at the same time from thirty-three to thirty-two degrees.

I have observed that in extreme cold weather, the vapor from the falls has a very sensible effect upon the temperature of the atmosphere, the mercury commonly standing four or five degrees higher within a few rods of the river, than it does at the distance of one fourth of a mile. JOHN M. BATCHELDER.

Saco, May, 1838.

| Days of the month. | April. | May. | June. | July. | August. | September. | October. | November. | December. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 32° | 45° | 60° | 70° | 72° | 64° | 57° | 42° | 34° |
| 2 | 32 | 45 | 61 | 70 | 71 | 63 | 57 | 42 | 34 |
| 3 | 32 | 45 | 62 | 70 | 71 | 63 | 57 | 41 | 34 |
| 4 | 32 | 45 | 63 | 70 | 71 | 63 | 56 | 40 | 34 |
| 5 | 32 | 45 | 63 | 70 | 71 | 64 | 55 | 40 | 33 |
| 6 | 32 | 46 | 63 | 70 | 70 | 64 | 53 | 40 | 33 |
| 7 | 32 | 46 | 63 | 70 | 70 | 65 | 52 | 39 | 33 |
| 8 | 32 | 46 | 64 | 70 | 70 | 67 | 51 | 37 | 33 |
| 9 | 32 | 47 | 65 | 70 | 70 | 69 | 50 | 37 | 32 |
| 10 | 33 | 48 | 64 | 70 | 69 | 70 | 50 | 37 | 32 |
| 11 | 34 | 48 | 64 | 70 | 69 | 68 | 50 | 37 | 32 |
| 12 | 35 | 50 | 64 | 70 | 69 | 67 | 50 | 37 | 32 |
| 13 | 36 | 50 | 63 | 71 | 68 | 67 | 49 | 37 | 32 |
| 14 | 36 | 50 | 64 | 71 | 68 | 66 | 48 | 35 | 32 |
| 15 | 37 | 50 | 64 | 72 | 68 | 65 | 48 | 34 | 32 |
| 16 | 37 | 50 | 65 | 72 | 68 | 65 | 47 | 34 | 32 |
| 17 | 37 | 50 | 64 | 72 | 68 | 65 | 46 | 34 | 32 |
| 18 | 38 | 50 | 62 | 72 | 69 | 66 | 47 | 35 | 32 |
| 19 | 38 | 50 | 63 | 73 | 70 | 65 | 49 | 35 | 32 |
| 20 | 39 | 50 | 62 | 73 | 71 | 64 | 49 | 36 | 32 |
| 21 | 39 | 50 | 62 | 73 | 70 | 63 | 49 | 36 | 32 |
| 22 | 39 | 51 | 63 | 73 | 69 | 61 | 49 | 36 | 32 |
| 23 | 39 | 52 | 64 | 73 | 68 | 60 | 49 | 36 | 32 |
| 24 | 39 | 52 | 63 | 73 | 68 | 60 | 49 | 36 | 32 |
| 25 | 40 | 53 | 64 | 73 | 68 | 60 | 49 | 35 | 32 |
| 26 | 40 | 54 | 66 | 72 | 68 | 59 | 49 | 35 | 32 |
| 27 | 42 | 55 | 66 | 72 | 68 | 59 | 49 | 34 | 32 |
| 28 | 43 | 56 | 66 | 72 | 68 | 58 | 48 | 34 | 32 |
| 29 | 45 | 58 | 67 | 72 | 67 | 58 | 47 | 33 | 32 |
| 30 | 45 | 59 | 68 | 72 | 66 | 58 | 44 | 33 | 32 |
| 31 |  | 60 |  | 72 | 65 |  | 43 |  | 32 |
| Mean Temp. | 36.63 | 50.19 | 63.77 | 71.39 | 68.97 | 63.53 | 49.87 | 36.57 | 32.39 |

7. *Asphaltic Mastic, or Cement of Seyssel.*—A pamphlet before us, has been published in London, by F. W. Simms, Civil Engineer, (8vo. pp. 27, 1837,) explaining at some length the great importance of the above cement, in the construction of pavements, roofs, floors, hydraulic structures, and other works of a similar nature. This cement is prepared from a bituminous limestone, found at Pyrimont, one league north of Seyssel, in the department of L'Ain, on the eastern chain of the Jura mountains. This limestone is inpregnated pretty uniformly by about nine per cent. of bitumen, and for the purposes of the arts is broken down to a fine powder, being previously roasted to drive off any water that might be present. It loses by the roasting about one fortieth of its weight, and becomes so loosely coherent as to be easily forced through a sieve, with meshes one fourth of an inch square. To the calcareous asphalte thus prepared, seven centimes in the hundred are added of bitumen, extracted at the same place from the *molasse* (silicious gravel and bitumen) which extends from the banks of the river Rhone, to the foot of the Jura, covering the last stratum of the superior calcareous oolite, of which these mountains are composed. This bituminous gravel is broken into egg-shaped pieces, and thrown into boiling water, by which means the bitumen is completely separated, with a yield of about fifteen to eighteen per cent. The bitumen and calcareous asphaltum are thrown together in the above proportions into iron cauldrons, carefully heated, and when liquid, a quantity of clean gravel also heated quite hot, is projected into the mass, and thoroughly incorporated by stirring. When it is rather more fluid than treacle, and begins to simmer, it is fit for use, and may be carried in buckets to the moulds, if the blocks of a pavement are desired; or if intended for lining walls of stone or brick, forming of roofs, and the like, the small gravel spoken of above, is omitted.

Its application to all the purposes of architecture where cements are required, in the construction of permanent floors, water tanks, &c., seems to promise the most substantial advantages. Several experiments have been made to test its strength as a cement, one or two of which we will cite. Thirty bricks were cemented together with the Asphaltic Mastic* of Seyssel: the whole length was 5 feet 7¼ inches, each brick being two inches thick.

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* The following are the retail prices of this material, both in its native and manufactured states, as charged by the company in Paris.

| | £ | s. | d. |
|---|---|---|---|
| "Asphalte in its native state, per 100 kilograms (about 219 pounds English) | 1 | 0 | 10 |
| Foot pavements, &c. &c. per metre superficial (1,196 square yards English) | 0 | 5 | 10 |
| Covering of roofs, per metre superficial | 0 | 7 | 6 |

"*Experiment* 1.—The length of thirty bricks was placed upon a fulcrum, or prop, as nearly in its centre as would admit of the projecting ends being in equilibrium: fifteen bricks were overhanging each side of the prop, and after being left in that situation for a length of time, it was ascertained that no sensible change had taken place in any of its parts.

"*Experiment* 2.—We next placed one end of the connected bricks upon a firm support, and then placed heavy weights to keep that end down, leaving twenty-two bricks projecting horizontally, quite unsupported except by the tenacity of the cement; this projection measured four feet one inch; the average weight of the bricks was five pounds each. After fifteen minutes thus suspended, the extreme end appeared to have descended near half an inch, but of this we were not quite certain: no further change was at all perceptible.

"*Experiment* 3.—This experiment was both unintentional and unsatisfactory; the workmen in removing the bricks to rest each end upon a prop, that we might place weights upon its unsupported middle, let one of the ends fall with its full force upon the ground, while the other end remained supported: a fracture was the consequence, but it was a brick that broke and not the cement.

*Experiment* 4.—Ten bricks in length were supported at each end, and the weight of 150 kilograms, upwards of 300 pounds, was placed upon the middle, and was allowed to remain fifteen minutes without undergoing the least change; additional weights were then added till they amounted to 303 kilograms, or upwards of 606 pounds, and after being exposed to this weight for ten minutes it broke at the middle brick; but, as in the third experiment, it was the brick, and not the cement, that had given way." pp. 9, 10.

After quoting an instance or two of the use of this material as a pavement, we must close our notice, and refer those who wish further

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The following are the prices at which Yorkshire stone-paving can now be obtained in the metropolis.

| | *Tooled.* | | *Rubbed.* | |
|---|---|---|---|---|
| | *s.* | *d.* | *s.* | *d.* |
| Three inch paving, per foot superficial - - - | 0 | 9 | 0 | 11½ |
| Four inch - - ditto - - - - - | 1 | 0 | 1 | 2½ |

The above are the prices of the small sized flag-stones; but where larger stones are required, such as are now employed for paving the bettermost streets, the Yorkshire landings must be used, the prices of which are as follows:

| | *Tooled.* | | *Rubbed.* | |
|---|---|---|---|---|
| | *s.* | *d.* | *s.* | *d.* |
| Four inch, per foot superficial - - - - - - | 1 | 8 | 2 | 0 |
| Five inch ditto - - - - - - - - - - | 2 | 0 | 2 | 4 |
| Six inch ditto - - - - - - - - - - | 2 | 10 | 3 | 2" |

information, to the pamphlet itself, or to Mr. F. W. Simms, Upper George Street, Greenwich, or 136 Fleet Street.

"The foot-path of the eastern side of Pont Royal, was laid down as an experiment two years and a half ago; and although it is stated, that as many as 30,000 persons pass and repass daily, yet it appears to be almost as perfect as when first put down; whereas the curb and other stones with which it is bounded have worn to a great extent. Our observations here confirm Chevalier de Pambour's statements.

"The whole of the foot-paths on Pont de Carrousal, have been down two years, and do not indicate the least wear whatever; this specimen is also submitted to a severe test from the vibrations of the bridge, which is of iron, but of so light a construction, that the vibration from passing carriages, is at least as great as that of the suspension-bridge at Hammersmith; yet it has withstood this, and also the action of two winters, without the least symptoms of cracking or decay."

"We cannot omit to mention the magnificent piece of pavement now nearly completed in the Place de la Concorde: in the centre of which the Egyptian obelisk is erected: 24,000 square yards are here being laid down in elegant Mosaic work, with the asphalte of Seyssel. The ease, rapidity, and simplicity with which this is formed, calls forth the admiration of all passers-by. The fluid mastic is spread to fill a mould, formed of bar-iron of the pattern desired, (at the Place de la Concorde, the design consists of large squares alternately black and white, each square having a circular disk in its centre of the contrary color to itself,) while the mastic is still fluid, a fine gravel is sifted over it, either white or black gravel according to the color required, and then as the mastic sets, the whole is beaten flat with wooden stampers of about fifteen inches long and nine broad; the pavement so done, and after a little wear, can scarcely be distinguished from granite."

"We will here place on record our observations of the method followed in the manipulations of the material, and the formation of the foundation to receive it, as adopted at the Place de la Concorde.

"First, the ground is made nearly level, or of the requisite slope, then the curb stones are laid by the mason, the surface of which is left about four inches above the ground; this space is filled within an inch of the top with beton, which is a substitute for the concerte of England. The beton here employed is thus constituted. A mortar is first made, consisting of one third of hydraulic lime, and two thirds of river sand, then one of mortar, with three of cleaned gravel well mixed, which form the beton: this must be well pressed on its bed, and the surface subsequently smoothed with a thin coat of mortar, similarly composed to that above described; the use of hydraulic lime is, that the beton and mortar may set more rapidly. When the whole is quite dry, and not till then, the Mosaic pattern may be set out in the mortar, and by means of flat iron bars, rings, &c. of the proper thickness (about half an inch) the moulds are formed, into which the fluid mastic is poured, and spread as before described." pp. 11, 12, 13.

8. *Rafinesque's Botanical Works.*—(Communicated.)—Professor Rafinesque of Philadelphia, began to print and publish in 1836, two great botanical works, which he states to be the result of his botanical researches for forty years, since 1796, in the two hemispheres.

The first is FLORA TELLURIANA, or Synoptical Mantissa of two thousand new or corrected families, genera and species of plants, from all parts of the earth, and thus the first work ever published in America, upon the general botany of both hemispheres. Three parts of three hundred and six pages, large 8vo. have been published already. One of one hundred and four pages, containing the introduction, natural classification, and generic rules; the second of one hundred and twelve pages, and the third of one hundred pages, include eight hundred new or revised and corrected genera and species with some new natural orders. He has particularly revised the families of Saxifrages, Gentianea, Polygones, Asphodelides, Helonides, Orchides, Astorides, Atriplexides, Labiatæ, Resedines, &c. This work is supplemental to De Candolle and Lindley, and contains many American genera.

The second work is NEW FLORA AND BOTANY OF NORTH AMERICA, supplemental to all other American floras, containing the genera and species omitted or mistaken by Pursh, Michaux, Torrey, Hooker, Beck, Elliot, &c. Three parts have also been published, forming a half volume of three hundred pages, 8vo. The first contains the introduction, geography, lexicon and monographs; the second, a historical sketch, and Neophyton of three hundred new or revised species of herbaceous plants, whereof eighty six are monocotyledons; the third, sylvan sketch and new Sylva of two hundred and thirty four new or corrected trees and shrubs. There are several complete Monographs of the genera Celtis, Morus, Spirea, Hydrangea, Hamamelis, Fagus, Forestiera, Ceanothus, and some new genera, Nestronia, Cladastis, Nudilus, Zanthyosis. Also, monographs of Lechea, Amphicarpa, Kuhnia, Peltandra, Eclipta, Crotalaria, Capsella, Baptisia, Gerardia, Iris, Tradescantia, &c.

Both are sold by the author, for one dollar each part, or five dollars for the six parts already published. We understand that he accommodates the botanists, by receiving their works in exchange, or else specimens of rare plants: and he receives subscriptions for the remainder of his botanical and zoological publications.

9. *Wonders of Geology, in two Vols.* 12*mo., with numerous plates and wood cuts;* by GIDEON MANTELL, LL. D., F. R. S., M. G. S., &c., &c.—This new work we have, within a few days, received from the respected author, and as the present No. of the Journal is near finishing, we hasten to give it a passing notice. Dr. Mantell's earlier works, among which were, Illustrations of the Geology of Sussex, 4to., with 42 plates, that on Tilgate Forest, 4to., with plates, The Geology of the South East of England, 8vo., with numerous plates and cuts, and many memoirs and tracts, were published when the author resided in his native town of Lewes, seven miles from Brighton. By his great industry and zeal, he redeemed, from the cares of an extensive and laborious practice in surgery, time enough to produce these fine works, which rank with the very first on the science of geology, and have raised the reputation of their author to a high standard, giving him both an European and a transatlantic fame. Dr. Mantell, during his residence at Lewes, collected a splendid, and in a great measure an unique museum, the most remarkable ornaments of which were the astonishing fossil bones and other reliquiæ of his own region, discovered chiefly by himself and his family. Of this museum we gave an account at page 162, Vol. 23, of this Journal.

A few years since, Dr. Mantell removed to Brighton, and there established his museum in appropriate apartments. It soon became a nucleus, around which clustered the Sussex Scientific and Literary Institution, and in its rooms were held instructive and entertaining conversaziones. On these occasions and in connexion with the museum, many interesting objects of nature and art were exhibited and described by Dr. Mantell and his friends, and thus a hope was conceived and cherished (we wish we could say, it has been *fully sustained*) that a permanent elevation might be given to the fashionable crowd which revolve around the court and the throne, during its temporary pilgrimages to this favorite point on the chalky shores of Albion.* In these efforts Dr. Mantell was, primus inter pares, (if indeed a compeer he had,) among many associates in science and literature, most of them his personal friends, who adorned those coteries, so novel, in a city devoted to the splendors of the court and the fashionable amusements of the high and noble gentry who revolve in its orbit.

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* Fifty-five miles south of London on the Channel coast.

For the sake of forwarding the great object in view, Dr. Mantell yielded to the wishes of his friends and the public, by giving occasional lectures on topics relating to the sciences which he has so successfully cultivated. Those who had read his various works, in which science, genius, and taste were warmed by a noble but disciplined and sustained enthusiasm, waited only to learn whether his powers as a public speaker (at that time, as we have been credibly informed, little inured to actual practice) were commensurate with his high attainments as an original investigator, and as a man of science and of intellectual vigor; nor were they disappointed. We are assured by numerous public statements in the Brighton papers, as well as from independent sources, that his success in this character was fully commensurate with his previous reputation. In consequence, he was called upon to give a regular course of lectures on geology and the connected sciences, aided by his magnificent museum and by ample illustrations from drawings.

We have already mentioned this course of lectures, and we copied an abstract of one lecture, as given in a Brighton paper. (See Vol. 33, p. 328 of this Journal.) It was numbered 1, and we intended, as then announced, to make other extracts from time to time; although extraordinary absences and engagements have suspended the selection, we still cherished the design, when the arrival of the work announced at the head of this notice, superseded our purpose, in a way which we could not well explain, without this introductory statement.

The WONDERS OF GEOLOGY of Dr. Mantell contain the substance of the lectures given by him at Brighton, and thus the public are put in possession, in a concise and perfected form, of the whole of the stores of knowledge from which we intended to cull the most instructive and inviting parts. We shall not, however, feel precluded from proceeding again with our original purpose, especially, should the work not appear in the bookstores of this country.

It contains, indeed, the principal wonders of geology; but it would be great injustice to consider it as a mere collection of *mirabilia.* It embraces a regular system of geology, exhibiting its leading facts, and clearly elucidating its philosophy, the latter being the great object of the work, to which the facts, as a basis, are only auxiliary.

The arrangement is, from the alluvial and diluvial down through the tertiary, secondary and transition to the primary rocks, and all the igneous formations; ending with the actual ignivomous mouths, as they appear in the existing volcanos. The form of lectures (of which there are eight) is preserved, with the appropriate style and address, and with the references to the objects presented by way of illustration.

Although the lectures are necessarily long, (since the whole story of the actual structure of the crust of the globe and of its basis is told, as far as we know it,) they are conveniently divided under numerous heads, printed in small capitals, and thus the eye easily catches and reviews the various topics.

The plates are of the size of the volumes, so that there is no inconvenience from folded paper; and many appropriate wood cuts in connexion with the subjects, chequer the pages, and thus speak, through the eye, effectively to the mind.

Many things might be said as to the best arrangement for a course of lectures, or for a work on geology.

1. We may begin as Dr. Mantell has done, at the actual surface, and proceed from what we know and are familiar with, down through formations less and less known, until we arrive at the deep profound of the earth, the bathos of our ignorance; this is in the reverse order, both of the chronology and deposition of the strata. On the whole, this arrangement presents many important advantages, but leaves the igneous phenomena unexplained until a late period.

2. We may begin with the granite, the deepest rock of which we have any knowledge, and then in the ascending order, we meet only with materials with which we have been made acquainted, and of which the derivative rocks are constructed. We proceed also from animals and plants, the least known, or entirely unknown, through successive families, more and more assimilated to those of our own times, and end with those that are identical with the existing races.

3. We may begin with the granite and ascend through the ignigenous rocks to the surface-fires of the actual volcanos, and then, descending through them, to their deep foci, ascend again, through the schistose-primary, and fossiliferous rocks to the actual surface; or we may descend in the reverse order.

4. We may begin with the cones of active and extinct volcanos—descend through the igneous rocks to the granite, and then up as before, through the primary, transition, secondary and tertiary, to the actual surface, ending with the diluvial and alluvial.

Having ourselves tried all these methods in instruction, we have preferred the 1st and 4th; and of these two, the latter, as putting us in early possession of igneous agency, the most potent, and the most concealed of the causes connected with geological dynamics, and leading us naturally through the sequel of aqueous agencies with which we are better acquainted. Still, our preference for this course is so slight, that for the sake of leading on a class by the aid of so instructive and delightful a guide as these volumes afford, we should not hesitate to adopt that course which Dr. Mantell has chosen.

Thus much of the order; now of the execution of the WONDERS OF GEOLOGY. After the ample proofs of talent, science, skill, taste and enthusiasm, regulated by a severe induction, which Dr. Mantell had before given us, it would indeed have been surprising if his last work had not been worthy of its predecessors and of its author; with pleasure we add, that it fully sustains its claims to the lineage whence it has sprung.

In point of science it is precise, accurate, condensed and cumulative in proof, conducting the pupil forward by a series of steps, grateful in the progress and conclusive in the result; no important facts are omitted and none are unduly expanded.* The style is lucid and flowing, but simple and elevated, while the figures render every thing intelligible, even to the unprofessional reader.

The introduction which precedes, and the retrospect which closes the account of each formation, afford an admirable summary both of facts and doctrine, and are distinguished for graphic power, eloquent diction, and comprehensive views.

The greatest excellence of Dr. Mantell's work is, that it affords an excellent pioneer and conductor for the pupil attending a course of lectures, and even for the private student, who has to work his own way without a guide. In both these respects, it is superior to any book with which we are acquainted, and we shall be gratified should it be in our power to introduce it to the American public under a form in which it can reach the colleges† and academies and schools—not to mention the studies of literary men, and the parlors of families. It is a work of delightful entertainment as well as of instruction, and although less elaborate than the original works of investigation of the same author, it will find its way to many more readers, and will, therefore, be even more extensively useful than they have been.

The author modestly disclaims the merit of originality, having, as he says, only strung together the beautiful pearls collected by others, while he has merely furnished the string. But his friends will not permi this merits to rest here. They will not forget, that his own original investigations have been among the most successful of the age, and their results among the most brilliant obtained by geologists.

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* If there be any part which some persons might regard in this light, it would probably be what relates to the local geology of the English and French secondary and tertiary; for ourselves, however, we should decidedly prefer this fullness, especially, aided as we have been by our English friends, (and by none so much as by Dr. Mantell himself,) with the specimens necessary to the elucidation of these formations. In this country, geologists might wish a more ample account of the granitic and primary family which on this continent, and especially in the Eastern States, makes a great figure.

† We hope soon to be able to take similar ground with respect to a new work of Mr. Lyell—Elements of Geology, in one volume, now in the press in London. Mr. Bakewell's new edition, of which a reprint was promised in our last number, has not yet, to our knowledge, arrived in this country.

"Commencing with the human epoch, he proceeds through the various systems which preceded the creation of man, and the several eras of the gigantic elephant; of the tertiary; the chalk; the weald; the oolite and lias; the corals; the carboniferous strata, and the primary rocks, are by turns the subject of instructive and delightful comment. The work is illustrated with much taste; a frontispiece from the *burin* of Martin gives a representation of the country of the Iguanodon, representing these monsters of the ancient world attacking and devouring each other; two drawings of corals, tastefully designed, and splendidly colored by the pencil of Miss Mantell, form embellishments of first-rate beauty and interest, and nearly a hundred wood engravings with colored sections of strata, maps, &c., bestow at once pictorial grace and scientific illustration on the volumes. A work commencing as does this with the most recent periods, and advancing to those incalculably remote,—in a word, proceeding from the human epoch and the connection of man and his works with the mutations of the earth, through periods in which no traces of mankind are discoverable, but animal and vegetable remains alone occur, down to the primary rocks themselves, in which no organic remains have hitherto been supposed to exist,—comprises a vast, an almost unlimited, field of inquiry, and requires in the writer who should justly describe them, qualifications and powers of no common character.

"Dr. Mantell has acquitted himself admirably of the arduous task which he has chosen; and, as a valuable collection of scientific data—as an able generalization of facts—as a clear and lucid statement of the chief principles and most important deductions of geology—in short, as a highly valuable and useful epitome of the Encyclopædia of geological science, we should unhesitatingly recommend this work as superior, in many essential particulars, to any yet published. Its plan displays that lucid arrangement and order which eminently characterize the lectures of the author, and by which he is enabled to render objects, apparently uninviting or repulsive, in the highest degree attractive and pleasing: to attract and interest even the gentler sex with studies which philosophers themselves consider abstruse and severe, and thus to show that philosophy is—

"Not harsh or crabbed, as dull fools suppose,
But musical as is Apollo's lute."

"Each lecture is arranged under important and attractive heads; these are referred to in a copious index; while the most difficult scientific terms are explained in a glossary; so that he who runs may read."—*Brighton Herald, (Eng.) paper, March* 31, 1838.

The present work, like others of the same author, is distinguished by a reverent spirit towards the Author of nature, who appears to be sometimes forgotten by those who investigate his works. Dr. Mantell's volumes will leave a happy moral and religious impression upon the minds of young persons; and thus science, in this department, as well as in others, will be seen to be the handmaid and ally of revealed religion.

It is an interesting fact, that among the fine writers of the present day, several of the geologists hold a very high rank, and their works, although devoted to science, are also an ornament to literature. Who can write better than Sedgwick, Buckland, Lyell, Greenough, Daubeny, Murchison, De La Beche, and Mantell, and many more geologists who might be named!

There is but one painful impression left on the mind, in closing Dr. Mantell's delightful volumes. He informs us that this is his farewell to science,* as he must henceforth be devoted to the practice of an arduous profession, and for this purpose he has already left the classical fields of his own geological domain—Tilgate forest and Brighton cliffs and the Chalky Downs of Sussex—to plant himself in a suburban village,† as a practising surgeon.

We were thus plaintively reminded of Blackstone's touching farewell to the Muses, when he was about to enter the gloomy halls of the courts of law; and still more forcibly, of the struggle of Garrick between Comedy and Tragedy, as portrayed by the magic pencil of Reynolds—each rival sister wooing him with admitted and almost prevailing claims and attractions. In the present contest between surgery and geology, each striving to appropriate to itself an honored votary, we dare avow, that our loyalty is, at all hazards, engaged in favor of geology; and if a transatlantic republican might dare to waft in the western breeze a whisper that, perchance, may cross the ocean and reach the ear of the youthful, lovely, and excellent British Queen, it would be, *that a man who has honored the British nation, and delighted the scientific world by his beautiful researches, might be made easy* to pursue the bent of his own glowing and gifted mind, and thus *to work onward in science, until the work of life is done!*

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* At least, as a lecturer.

† Clapham Common, near London, distinguished as the former residence of many great and good men, among whom were the Thorntons, father and sons, Lord Teignmouth, and Wilberforce.

10. *Report accompanying the Map of the extremity of Cape Cod, Mass., executed during portions of the years* 1833, 1834, *and* 1835; by **James D. Graham**, Major U. S. Topographical Engineers. Doc. No. 121. Jan. 1838. 8vo. pp. 101.—This valuable document is chiefly occupied with tables showing the flow of the tides at Provincetown Harbor, and at Race Point, Cape Cod, Mass., in 1833, 1834, and 1835, and with quarter-hourly tide tables kept at Provincetown Harbor, in June and July, 1835. The observations were made and the tables prepared under the direction of Major Graham. They have evidently cost much persevering labor, and are very creditable to all concerned. Observations on the phenomena of the tides are at the present day receiving much attention from men of science in various parts of the world, and we have no doubt this contribution will be gladly welcomed by all those engaged in the elucidation of this interesting subject.

11. *Prodromus of a Practical Treatise on the Mathematical Arts: containing directions for Surveying and Engineering;* by **Amos Eaton**, A. B. and A. M., Senior Professor in Rensselaer Institute. 8vo. pp. 191. Troy, N. Y. 1838.—The author in his preface states, that this volume is made up of selections from a mass of heterogeneous materials which he has been depositing in his common journal for more than thirty years. It is a large collection of miscellaneous hints, principles, rules and processes in practical science. The following list of the titles will furnish a partial idea of the topics treated of:—Arithmetic, Trigonometry, Mensuration, Land-Surveying, Statics and Dynamics, Mechanical Powers, Architecture, Rail Roads, Excavations and Embankments, Canals, Roads in general, Water works, water power applied to milling, &c., Topography, Materials for construction, Useful Rocks and Cements, Timber materials, Iron materials. It is not easy to give an abstract of a work of this nature. A brief inspection has satisfied us that it contains much valuable matter, and that it cannot fail to be of great service to all engaged in the business of engineering.

12. *Hydrogen gas in a lead pipe, used as an aqueduct,* in a letter to the Editor from **Nelson Walkly**.—I was at the house of a friend during the last summer, and while there, he was engaged in laying lead pipe from a spring to his house for conducting the water, a distance of three quarters of a mile.

Between the spring and his house was a hill several feet higher than the spring, and several whose summits were not as high. His house was fifteen feet lower than the spring. He informed me that he had laid down his pipe several times and set the water running, but it never had continued to run over ten days at a time. He had repeatedly taken it up and tried it, supposing it contained a leak. He called on the man whom he had originally employed to lay his pipe, for a cause, and found that he knew nothing, except that the stoppage was occasioned by air, and that air could not get in, unless there was a leak in the pipe. My friend, when I arrived, was taking up his pipe for the last time, to try whether there was a leak. After trying it with a pressure of 50 lbs. to the inch, he found no leak and laid down his pipe, and by means of a forcing pump set the water running again. As formerly, after running less and less for about ten days, it entirely ceased. I then took it in hand, determined to find out, if possible, the cause of the obstruction. I made a puncture in the pipe at one of the high places lower than the spring, and found that the pipe contained not air, but hydrogen gas. I was now more embarrassed than before, as I could not imagine what was the source of the hydrogen. I happened about that time to take a tin cup of water, and noticed a row of minute bubbles along the seam; the thought struck me, that it was the combination of metals in the pipe that occasioned galvanic action sufficiently powerful gradually to decompose the water.

To try it, I put a small piece of the same pipe into a tumbler of water, and after standing two days, I found the pipe covered with a coat of white oxide, with the exception of the seam where it was soldered together, and there the tin which composed the solder was perfectly bright. From this I inferred, that the galvanic action of the pipe on the water produced decomposition, the oxygen combining with the lead, and the hydrogen carried along by the water until it came to the high places in the pipe, and there accumulated until it filled the pipe and entirely obstructed the water.

To remedy this difficulty, I made holes into the pipe at every high place, and soldered over them a vertical tube, open at the top, excepting the hill that was higher than the spring, and to that part of the pipe I soldered a tube similar to the others, with this exception, that I soldered it up at the top. The first mentioned tubes let the gas escape as it came along, and the one on the highest elevation suffered the gas to accumulate in it until a small bubble protruded below the end of the vertical tube, and was detached from the body of the gas in the tube and carried on by the water. After the above arrangement was effected, the water was set running, and has continued to run without any sensible diminution ever since, upwards of eight months. Query. Is not the action of water upon lead, mentioned in Vol. xxxiv, p. 25, of this Journal, occasioned by a combination of some other metal with the lead?

Tuscaloosa, Ala. May 25th, 1838.

13. ***Bituminization of peat and conversion into coal.***—At page 73 of the present volume this fact is mentioned; the following more full notice of it is contained in Dr. Charles T. Jackson's Report on the Geology of Maine, pp. 80, 81.

"In Limerick we examined the peat bogs on the estate of Mr. Ebenezer Adams, where a very remarkable substance is found resembling exactly the cannel coal. It is found at the depth of three feet from the surface of the peat bog, amid the remains of rotten logs and beaver sticks, showing that it belongs to the recent epoch. The peat is twenty feet deep, and rests upon white siliceous sand. This recent coal was found while digging a ditch to drain a portion of the bog, for the sake of obtaining peat as a manure; about a peck of it was saved, and served to supply us with specimens. On examination, I found that it was formed from the bark of some tree allied to the American fir, the structure of which may be readily discovered by polishing sections of the coal, so that they may be examined by the microscope.

"It contains in 100 grains,

| | |
|---|---|
| Bitumen, - - - - | 72 |
| Carbon, - - - - | 21 |
| Ox. Iron, - - - - | 4 |
| Silica, - - - - - | 1 |
| Ox. Manganese, - - - | 2 |
| | 100 |

"This substance is a true bituminous coal, containing more bitumen than is found in any other coal known. I suppose it to have been formed by the chemical changes supervening upon fir-balsam, during its long immersion in the humid peat.

"The discovery of the recent formation of bituminous coal, cuts the gordian knot which geologists and chemists are endeavoring to unravel, and shows that the process is still going on. The difference between bitumen and resin is not very great, and the absorption of a small quantity of oxygen is all that is required to effect the change. Other localities of this curious substance, may be found by searching the numerous peat bogs in other parts of the state."

*The coal measures of Mansfield, Mass.*, are in the conglomerate or graywacke; a fact that would not be readily admitted in England. It is evident that our conglomerate rests on sienite, and alternates with the argillaceous slate rocks: also, that its mineralogical composition and structure, as well as its position, stamp it as a graywacke formation; and yet it is full of coal plants! I have collected fourteen or fifteen species there during three visits to the mines.*

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* Extract of a letter to the Editor from Dr. Jackson.

14. *Denial of a charge of plagiarism;* by Dr. W. C. Wallace, Surgeon to the Institution for the Blind.—In the London Magazine of Natural History, for March, 1838, there is the following statement, by John Dalrymple, Esq., Lecturer on Surgery at Sydenham College.

"Some few years back, in examining the organ of vision in a pike, (*Esox lucius,*) I observed a small roundish grey colored body, about the size of a hemp-seed, attached to the circumference of the lens; and at the same time, certainly without due consideration, I designated it a muscle, principally from the fact, that I traced a nerve running from the posterior part of the eye, to this peculiar body. The preparations then made I exhibited to some young American gentlemen, attending the practice of the Moorfields Ophthalmic Hospital."

"That the existence of this body is yet unknown in England, at least, is I think borne out by the fact, that the learned Professor of Comparative Anatomy at the Royal College of Surgeons, Mr. Owen; and Mr. Yarrel, so well known by his beautiful work on the ichthyology of Great Britain, were both unacquainted with the circumstance when I mentioned it to them."

"In a number of the American Journal of Science and Arts, will be found a somewhat similar account of a muscle, discovered in the eye of the streaked bass, (*Perca nobilis vel Mitchilli,*) by Mr. W. Clay Wallace, surgeon to the New York Institution for the Blind. This gentleman did me the favor to send me over about twelve months since, his paper published in that Journal. From the circumstance of my not being aware of being personally acquainted with Mr. Wallace, *I cannot help suspecting that he is one of the Americans to whom the observations made by me were imparted at the Ophthalmic Hospital some years ago.*"

In justice to the young American gentlemen attending the practice of the Moorfields Ophthalmic Hospital, I deny, says Dr. Wallace,* that I ever saw or heard of Mr. Dalrymple, previous to the publication of my discovery in 1835, or that I ever had, directly or indirectly, any communication with any person who had seen, or even heard of him or his imparted observations. Mr. Dalrymple published an elaborate work on the eye, a copy of which was presented to me by a highly valued friend in the year 1835. As there was nothing definite stated in his work about the means by which the focus of the eye is regulated to different distances, nor of the body attached to the crystalline lens, I immediately forwarded him a copy of my paper. From this statement it is obvious, that if I were disposed to deviate as far from candor and courtesy as Mr. Dalrymple has done, I might with far greater plausibility, turn the tables upon him and say; *I cannot help suspecting that he is one of those to whom the observations made by me were imparted through the medium of Silliman's Journal in 1834, and now published as his own in the Magazine of Natural History, in* 1838.

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* In a letter to the Editors of this Journal.

15. *Gold in Georgia.*—A correspondent in Georgia, intimately acquainted with the gold mines there, informs us recently that, although the gold is of a very superior quality, averaging 940 to 1000, the deposit mines are nearly exhausted, and until labor in this country becomes redundant, it is doubtful whether the vein mines will pay the expense of working them.

16. *Yale Natural History Society.*—This Society has been already mentioned in our pages. The progress of institutions of this nature must always be slow, especially during the first years of their existence, and before a considerable library and museum, and important transactions have called public attention to them. Already, several valuable original papers have been published, by the Society, in this Journal, evincing originality and accuracy of scientific investigation, and illustrated by ample and finished engravings, by no means unworthy of older and more celebrated associations. We learn that it is the intention of the Society, as soon as practicable, to collect these papers, and to publish them as transactions. It has doubtless been an advantage to the Society, that they have been able to place their memoirs before the public so soon after their being ready, and it is to be hoped that they will always be able to do so.

The museum of the Society has advanced faster than was expected. A valuable collection of several hundred species of birds was received two years since from a member in China, (Dr. Parker,) and the liberality of the public has enabled the Society to display them to great advantage. Their collections in the other departments of zoology, and in botany, are small, but a nucleus is formed in each. The specimens collected by Prof. C. U. Shepard, illustrative of the geology of this State, were, by the permission of his Excellency Gov. Edwards, deposited in the Society's rooms, and constitute a cabinet of more than ordinary interest.

The library is yet small, but the means exist to a certain extent, of increasing it as soon as is deemed expedient. Some additions have been made to it during the past year, of which none are more important than the Transactions of the Zoological Society of London. An effort was just commencing by the Society to raise a fund of $20,000 for the increase and support of the library; but before much could be done, the pecuniary embarrassment of the country came on; and it was deemed expedient to withhold all solicitation after about $1,700 had been pledged. William Maclure, Esq. of Mexico, (to whose patronage the Academy of Natural Sciences in Philadelphia chiefly owe their present prosperity,) with his usual liberality, gave the sum of five hundred dollars to the library, free of all conditions.

17. *Meteoric Shower in April.*—The fact that a meteoric shower occurred about the last of April, 1803, seemed to furnish reason for the expectation that an unusual display of meteors might, by proper efforts, be detected at this season of the present year. According to the best information obtainable, that shower occurred on the morning of the 20th of April, 1803. Arrangements were consequently made for observations on the morning of April 20, 1838, at Porto Rico, W. I.; Tuscaloosa, Ala.; Knoxville, Tenn.; Hudson, Ohio; Buffalo, N. Y.; New York City, and New Haven. From Porto Rico no returns have been received. At Tuscaloosa, observations were accidentally omitted. From Hudson, Ohio, Prof. Loomis reports that the weather was unfavorable, but that between 3½*h.* and 4*h.* A. M. it was clear in the east, and nothing unusual was seen. At Buffalo, N. Y. observations were made on the morning of the 21st, by Mr. R. W. Haskins and Dr. C. H. Raymond. The sky was partially cloudy, but clear enough to permit them to decide that nothing uncommon was visible. The previous morning was overcast. At New York City, Mr. G. C. Schaeffer saw nothing unusual; but the view was much interrupted by clouds. At this place, observations on the mornings of the 20th and 21st detected nothing more than common. On the night of the 20th, at Knoxville, Tenn., Prof. Wright, with an assistant, saw 154 meteors between 10 P. M. and 4 A. M. of the 21st. This number is probably somewhat above the average, but how much above, additional observations are needed to determine.

The facts here recorded do not decide whether a meteoric shower did or did not visit the earth on or about the 20th of April, 1838. In a case of this nature, a negative cannot be established without a clear sky and numerous observers encircling the whole globe. E. C. H.

New Haven, Conn.

18. *Improvements in Magnetical Apparatus.*—At the meeting of the British Association, held in Bristol, in 1836, the Rev. W. Scoresby made a communication to the Physical Section, on an improved mode of construction in magnetic needles for compasses, &c. by the combination in a parallel series, *not* in contact, of several thin plates of tempered steel. A variation instrument, which he at that time exhibited,

constructed on this principle, was stated to have a far greater directive energy than any instrument, of the nature of a compass, previously constructed. Since that period Mr. Scoresby has been pursuing, as opportunity offered, an extensive series of investigations on the subject; both as to the law of combination in steel plates and bars, and as to the effect of temper, thickness, &c. on the aggregate power; with the view of producing more powerful instruments for determining the delicate variations in, and the actual condition of, the earth's magnetism; a subject now engaging attention in some of the principal observatories in Europe. The results, which have been successful beyond the objects originally contemplated, have been recently communicated to the Institute of France. One of these results likely to be of much importance in magnetical science, to which it is extensively applicable, is that of producing permanent artificial magnets of almost unlimited power. On the principle of construction of compound magnets hitherto adopted, only a very limited number of bars could be combined with advantage, in consequence of the great deterioration of power occasioned by the condition of violence. Mr. Scoresby found, on combining very superior plates of tempered steel of two feet in length and about $\frac{1}{24}$th of an inch in thickness, that the first six plates received so much power that no additions, however great the number, were capable of producing more, in the aggregate, than about double that power. Aiming, however, to counteract the tendency to such rapid deterioration, Mr. Scoresby made some magnetical combinations of *perfectly hard* steel plates, (which he has a ready method of magnetizing and testing,) by means of which an almost unlimited power can be obtained. Already this combination has been carried, with no inconsiderable augmentation of the aggregate energy, to the very last, to the extent of several dozens of hard plates, 15 inches in length, so as to produce, by such combination, a compound magnet of very extraordinary power for its mass. The application of this principle to apparatus for magnetic electricity will obviously be of much advantage for compactness and power; whilst the application of the discovery to variation needles, dipping needles, and, probably, to sea compasses also, promises to be of much importance in experimental science, as well as for practical and economical purposes. Mr. Scoresby's investigations have also led to other practical results, such as the means of testing most rigidly the quality and temper of steel plates, and of bars intended for compound magnets on the ordinary construction, by which the best plates can be selected and the most powerful combinations may be obtained.—*Lond. and Edin. Phil. Mag.*, *April*, 1838.

## 19. *Meteorological Society,*

[Established in 1823,—revived in 1836.—47, Hatton Garden, London.]

### *Officers for the Sessions* 1838 *and* 1839.

*President*—George Birkbeck, M. D., F. G. S., &c.

*Vice Presidents*—Æneas Mc. Intyre, LL. D., F. L S., M. B. S., &c. Richard Taylor, Esq., F. R. S., F. R. A. S, &c.

*Treasurer*—Charles Shearman, Esq., F. R. A. S., &c.

*Secretary*—W. H. White, M. B. S., &c.

*Other members of the Council*—Charles Henry Adams, Esq. W. R. Birt, Esq. The Right Honorable Lord Robert Grosvenor, M. P. Sir J. F. W. Herschel, K. H., F. R. S., F. A. S., &c. Samuel Luck Kent, Esq., F. G. S., &c. John Lee, LL. D., F. R. S., F. A. S., P. N. S., &c. Jonathan Pereira, Esq., F. L. S., &c. Captain Sir John Ross, R. N., F. R. S., &c. John Reynolds, Esq., M. B. S. James George Tatem, Esq. Robert Carr Woods, Esq.

The number of members amounts to sixty-two, of which ten are *honorary* and twelve *associate members.*

The Council refers with pleasure to the very interesting and valuable communications, amounting to upwards of sixty, received during the last fifteen months, from the following gentlemen :—C. H. Adams, Esq., Edmonton,—Wm. Addison, Esq., Great Malvern,—W. R. Birt, Esq.—H. W. Bailey, Esq., Thetford,—Rev. W. T. Bree, Allesley Rectory,—Rev. W. B. Clarke, A. M., F. G. S., &c., Poole,—Dr. Clutterbuck, London,—Charles Conway, Esq., M. B. S., Near Monmouth, —Professor Cerquero, Astro. Royal San Fernando,—Wm. Gardiner, Jun., Esq., Dundee,—Lieut. Grey, Associate, Australian Expedition, —J. W. G. Gutch, Esq., Swansea,—Sir J. F. W. Herschel, K. H., F. R. S., F. A. S., &c., Feldhausen, South Africa.—Graham Hutchison, Esq., Glasgow,—Samuel Luck Kent, Esq., F. G. S., High Wycombe,—Lieut. Morrison, R. N., M. B. S., Galway,—S. Moss, Esq., Cheltenham,—Henry Ommanney, Esq., Australian Survey,—Professor Olmsted, Yale College, United States,—John Prideaux, Esq., Plymouth,—Professor Quetelet, Royal Academy, Brussels,—Capt. Sir John Ross, R. N., F. R. S.,—John Ruskin, Esq., Oxford,—Capt. Smyth, R. N., F. R. S., Observatory, Bedford,—J. G. Tatem, Esq., High Wycombe, Bucks,—J. Templeman, Esq., St. John's, Newfoundland,—R. C. Woods, Esq., London,—and others, who are not members of the society.

The thanks of the society, are due to the following contributors to the society's library,—The Albany Institute,—The South African Institution,—Prof. Quetelet,—Prof. Olmsted,—M. D'Avezac,—Graham Hutchison, Esq.—Patrick Murphy, Esq.—Lieut. Morrison, R. N. —Prof. Whewell,—Capt. Smyth, R. N.—Dr. Lee, F. R. S.—&c. &c.

As soon as the funds of the society will permit, the Council will publish several interesting papers, illustrative of meteorological phenomena; in which important proceeding they will be greatly assisted, by the valuable observations made by Sir J. F. W. Herschel, at the Cape, in the period during which he has been stationed in that interesting portion of the globe.

The Council requests that all communications or donations of books, instruments, &c. may be forwarded to the secretary, No. 47, Hatton Garden, London.

We have learned with pleasure by a letter from the secretary, Mr. White, dated April 2d, 1838, that this important society is proceeding with fair prospects of success. We invite the attention of American meteorologists to the great importance of coincident observations in this country, upon the plan recommended by Sir. J. F. W. Herschel, of which we have received an example from the society for 37 hours, commencing at 6 A. M. of the 21st of March, and ending at 6 P. M. of the 22d. The plan has, we are aware, been carried into effect in several places in the United States, and the results made public by the Albany Institute; but it is very desirable that observations of this nature should be multiplied, and that scientific individuals in every part of our land should lend their aid to an object so important.

We have also received a copy of the laws and regulations of the society, which appear judiciously devised, and it will give us pleasure to aid its efforts in any way in our power. We give the result of its observations for the 37 hours named above.

| MAXIMUM OF THE 21st. | | MAXIMUM OF THE 22d. | |
|---|---|---|---|
| On the Earth, - - | 48° 2 | On the Earth, - - | 42° 5 |
| 4 feet above do. - | 50 0 | 4 feet above do. - - | 49 0 |
| 30 feet above do. - | 53 0 | 30 feet above do. - | 46 0 |

| MINIMUM OF THE 21st. | | MINIMUM OF THE 22d. | |
|---|---|---|---|
| On the Earth, - - | 34° 5 | On the Earth, - - | 32° 5 |
| 4 feet above do. - | 35 0 | 4 feet above do. - - | 35 0 |
| 30 feet above do. - | 33 0 | 30 feet above do. - | 34 0 |

20. *London Electrical Society, and Annals of Electricity, Magnetism and Chemistry, &c.*—To this important branch of knowledge a distinct journal is now devoted, and a society has been formed for its more assiduous cultivation.

The journal, which at first appeared quarterly, is now published monthly, under the able supervision of Mr. William Sturgeon, lecturer on Experimental Philosophy at the Honorable East India Company's Mil. Sem. Addiscombe, &c. &c.

In the journal are contained, not only original British papers, but reprints or abstracts of the principal things published on these subjects in other European countries and in the United States. Figures are liberally supplied in handsome lithographed plates, and we cannot doubt, that a periodical work on these very important subjects, conducted with so much spirit and ability, will be fully sustained and prove eminently beneficial. We heartily wish it success, and hope it will be extensively *patronized* in this country. The price of each No. is 2*s*. 6*d*. sterling. Mr. Sturgeon is assisted by gentlemen eminent in the departments of philosophy to which the journal is devoted.

The Electrical Society have commenced their publications in a quarto* form; the first No. contains the rules and regulations of the society, and a manly, sensible, introductory discourse, by Mr. Sturgeon, setting forth the objects in view. The second No. contains two papers on important subjects.

1. The action of the Voltaic battery shown to be two-fold, and the distinction between the terms quantity and intensity determined by the theory of vibration; with a reply to the various objections made to the theory, by Mr. Thomas Pollock, read Oct. 21st, and Nov. 4th, 1837.

2. Description of some experiments made with the Voltaic battery, by Andrew Crosse, Esq., of Broomfield, near Taunton, for the purpose of producing crystals, in the process of which, certain insects constantly appeared. Communicated in a letter, dated Dec. 27th, 1837, addressed to the secretary of the London Electrical Society.

21. *Columbite and tin-ore at Beverly, Mass.*—Prof. Shepard finds small 12-sided prisms of columbite and hemitropic crystals of tin-ore, in the green feldspar-rock, discovered by the late Dr. Cornelius.

### 22. GEOLOGICAL AND OTHER REPORTS.

We have before us,

1. Dr. Charles T. Jackson's Second Report on the Geology of Maine. Augusta, Maine. 1838. pp. 168.
2. His Second Annual Report on the Geology of the public lands belonging to the States of Massachusetts and Maine. pp. 93.
3. Professor Hitchcock's Report on the Re-examination of the economical Geology of Massachusetts, in relation to its soils, agriculture, fuel, ores, &c. &c.
4. Second Report on the Geology of New York, being State document No. 200. pp. 384.

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* A very inconvenient form for *an active society,* whose publications ought to be easily portable without injury, even about the person, and as cheap as is consistent with efficiency and respectability.—*Eds.*

5. Annual Report of the Regents of the University. No. 52. March 1, 1838. pp. 220.

6. First Report on the Agriculture of Massachusetts, by Henry Colman, commissioner for the Agricultural Survey of the State. pp. 139.

7. First Annual Report of the Board of Education, &c. Boston. 1838. pp. 75.

8. Report of the Secretary of the Board of Education on the subject of School Houses, supplementary to the above. pp. 64.

9. The statistical tables of Massachusetts. Except the last, which was mentioned at p. 213 of this volume, these reports, important as they are, must, for the present, stand with only a titular enrollment. We have fully the will, but at present, have not the power to do more. We trust that some of them, and especially those on geology, will be mentioned hereafter.

*Journal of an Exploring Tour beyond the Rocky Mountains, in* 1835–6, and 7; by Rev. Samuel Parker, A. M. With a map and an engraving. Ithaca, N. Y. 1838. pp. 378, large 12mo.

Mr. Parker's tour was made under the American Board of Commissioners for Foreign Missions, with particular reference to the Indians. This main object is kept steadily in view, and there is much valuable information in the work in relation to the aborigines, whose interesting condition and ultimate prospects are deservedly exciting the sympathies, exertions, and contributions of the christian people of the United States.

The work contains also numerous facts of deep scientific interest, especially in relation to the ample and decisive proofs of igneous action and of earthquakes in the Rocky mountains, and the country between them and the Pacific. It would give us pleasure to make an abstract in relation to trap, basalt and undoubted modern volcanic products, but as we have neither room nor time, we can only recommend the perusal of the work both to the lovers of nature and of man.*

*British Annual and Epitome of the progress of Science, for* 1838, edited by Robt. D. Thomson, M. D. Lond. 1838. 18mo. cloth, lettered. pp. 387. This valuable work was preceded last year by a similar volume, containing Recent progress of Optical Science, by Prof. Powell; Experiments and Observations on visible Vibration and Nodal division, by C. Tomlinson, Esq.; Recent Progress of Astronomy, by W. S. B. Woolhouse, Esq., &c.; the History of Magnetical Discovery, by Thomas Davies, F. R. S., &c.; Recent Progress of Vegetable Chemistry, by Robt. D. Thomson, M. D.

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* We cannot, however, entirely recommend the cosmogony of the 16th chapter, and a few words, which we could wish had been omitted, especially as the style is in general, simple, lucid, and graphic.

The present volume contains a calendar with ample astronomical information, by W. S. B. Woolhouse, Esq., &c.

Contributions to a table of the Chronology of Science.

Weights and measures, English and Foreign.

Tables of the coins of different countries.

English and Foreign Universities, and Scientific and Literary Institutions and Libraries.

A new and beautiful numismatic process.

Sketch of the History and Present State of Geology, by Professor Thomas Thomson, M. D., &c.

On the Principles of Classification, as applied to the primary divisions of the Animal Kingdom, by Prof. Robt. E. Grant, M. D., &c., with numerous figures.

Notices of new chemical substances discovered during the past year, by Robt. D. Thomson, M. D.

Notice of the life of James Watt.

Queries respecting universities and seminaries of education.

These volumes are replete with valuable and interesting information, conveyed in a perspicuous and attractive form, and we trust will command the patronage which shall insure their continuance, year by year.

*Various Journals.*—We can only name,

1. The Indian Review of works of Science, and Journal of Foreign Science and the Arts, embracing Mineralogy, Geology, Natural History, Physics, &c. Edited by Frederick Corbyn, Esq. The three first numbers are missing—also the 13th, and the last received is No. 18, September, 1837, with an extra copy of 15.

2. The Hawaiian Spectator. Honolulu, Oahu, Sandwich Islands, No. 1. By an association of gentlemen. pp. 112.

3. The Gardeners' Magazine, and Register of Rural and Domestic Improvement. Nos. 36, 37, 38, and 39,—the latter for April, 1838. By J. C. Loudon, F. L. S., &c. Lond.

4. The Continental and British Medical Review, or Monthly Therapeutical Journal, by A. M. Bureaud Riofrey, M. D. Nos. 10, 11, and 12—the latter for February, 1838.

The Indian Review and Hawaiian Spectator, are memorable in the history of periodical literature, on account of the countries from which they come, and we cannot doubt, that they are an acceptable acquisition to the intellectual and moral world.

We hope hereafter to draw upon their pages to enrich our own.

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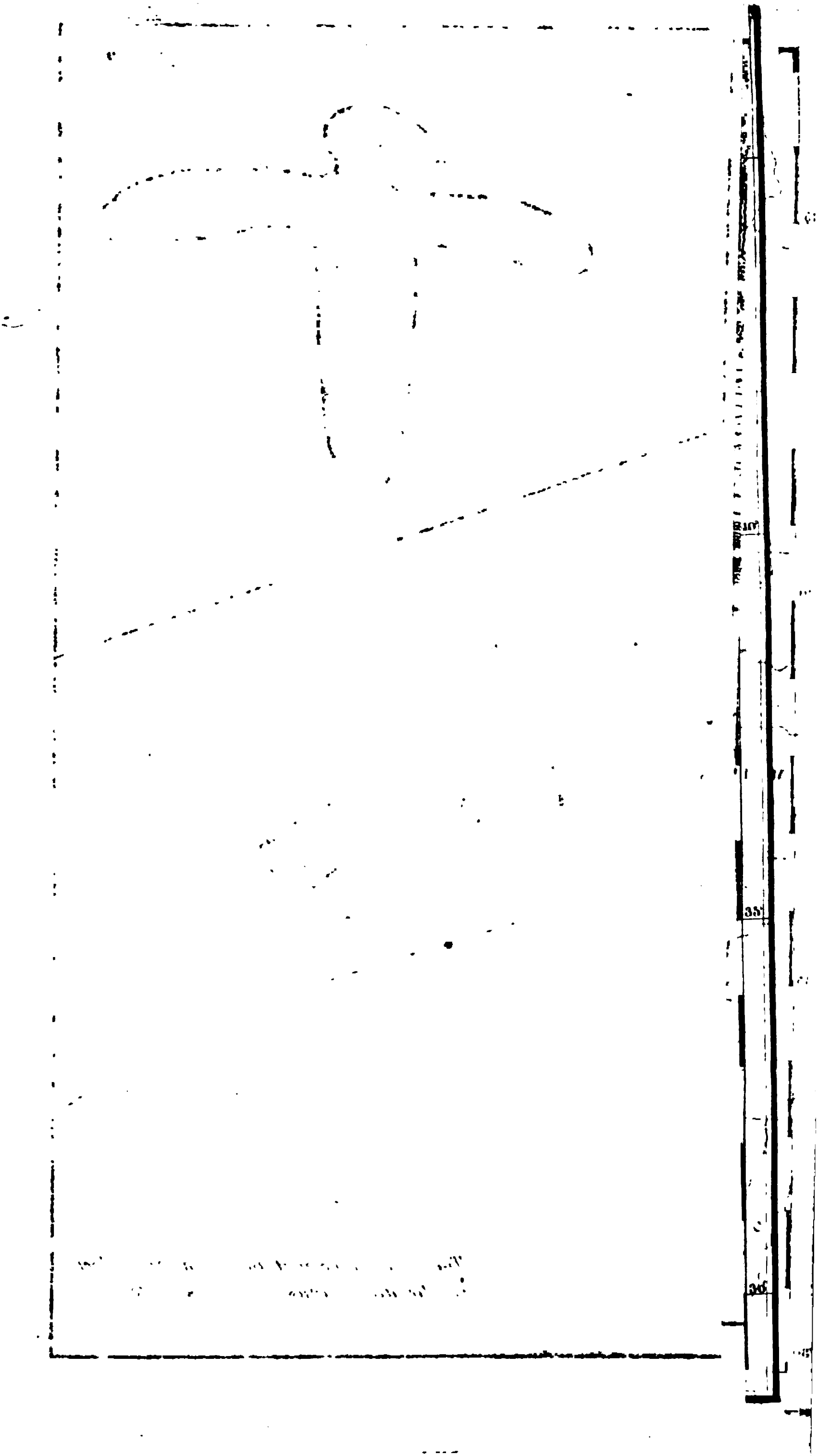
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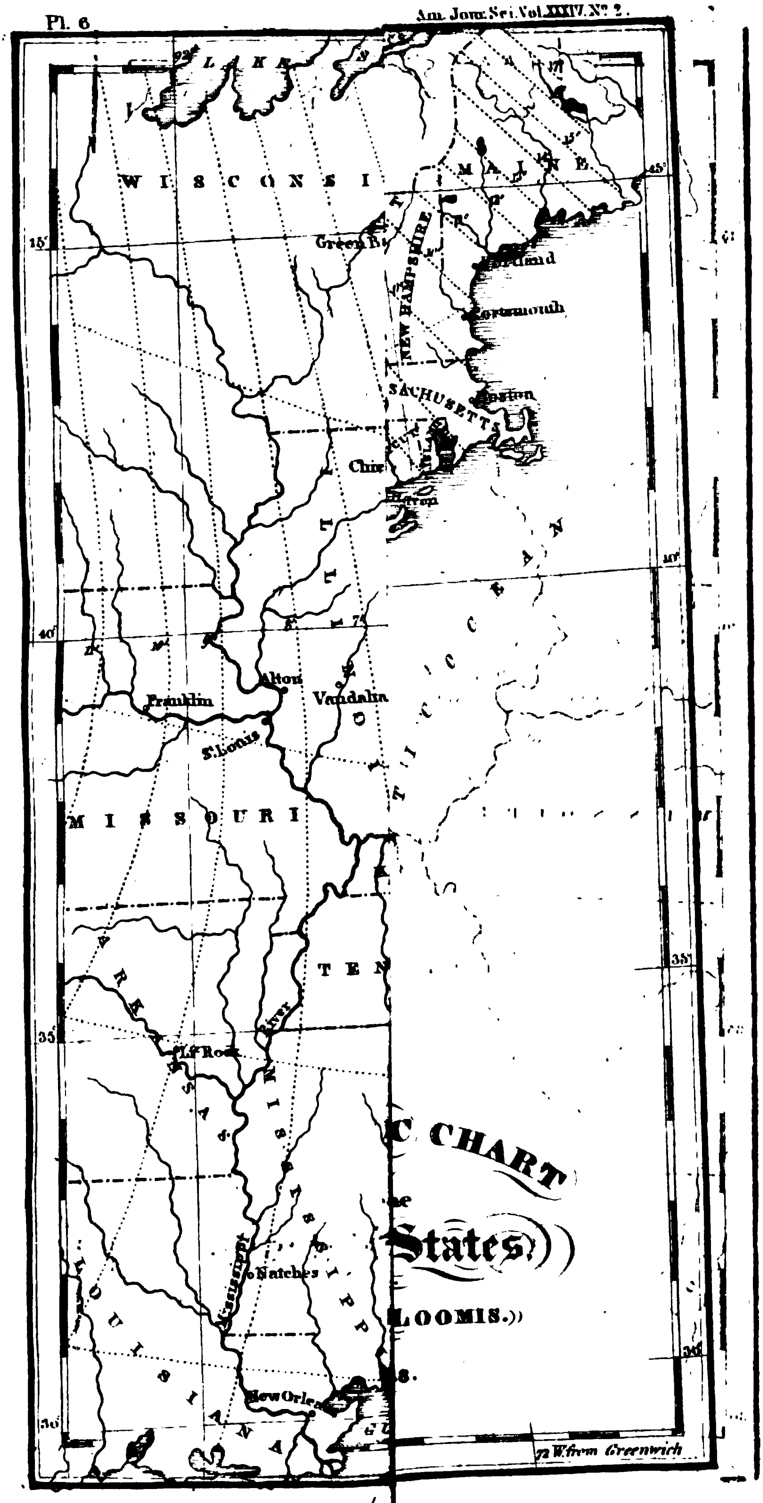
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# MR. BUCKINGHAM'S ADDRESS

## TO THE PEOPLE OF THE UNITED STATES.

*New-York, October* 25, 1837.

MEN, BRETHREN, AND FELLOW-CHRISTIANS:

THE numbers of human beings that every day approach your shores from all parts of the old world, must so familiarize you with the arrival of strangers from every quarter of the globe, as to justify your indifference toward all who do not ask your attention on some special account, since it would be impossible for you to show it to every individual of so countless a multitude, and without some grounds on which to establish exceptions, none could be fairly expected to be made. This consideration, while it will fortify me in the propriety of the step I am taking, will also, I trust, dispose you to lend a favorable attention to a short statement of the circumstances which have driven me to your shores, of the motives which impel me to the course I am pursuing, and of the objects which I hope, under the blessing of Providence, and with your aid and protection, to accomplish.

A train of events, much too numerous to be narrated in detail, occasioned me very early in life to leave my native country, England, and to visit most of the nations of Europe — still more of the interior of Asia — many parts of the continent of Africa — and some portions also of the two Americas. It was after an active life of some twenty years thus devoted, in which it fell to my lot to traverse, I believe, a larger portion of the earth's surface, and to visit a greater number and variety of countries, than almost any man living of my age, that I settled as a resident in the capital of the British possessions in India, where I remained for several years.

During the voyages and travels that I was permitted to make along the shores of the Mediterranean, amidst the Isles of Greece, in Asia Minor, Egypt, Nubia, Palestine, Syria, Arabia, Mesopotamia, Chaldea, Assyria, Babylonia, Media, Persia, and India, I had an opportunity of personally inspecting almost all the remarkable cities and monuments of ancient greatness in the several countries named; including the gigantic pyramids, colossal temples, stately obelisks, majestic statues, and gloomy catacombs and sepulchres, which stud the classic banks of the Nile, from Alexandria and Grand Cairo to the cataracts of Syene; the hoary mountains of Horeb and Sinai, and the Desert of Wandering, across which the children of Israel were led from out of the land of Egypt, to the promised Canaan; the plains of Moab and Ammon, with Mount Pisgah, the valley of Jordan, and the Dead Sea; the ruined cities of Tyre and Sidon; the ports of Joppa, Acre, and Cesarea; the villages of Nazareth and Cana of Galilee; the cities of Sechem, Samaria, and Bethlehem; the mountains of Lebanon, Hermon, Tabor, and Carmel; the Mount of Olives and Mount Zion; the holy city of Jerusalem, with all its sacred localities, from the pools of Siloam and Bethesda, near the brook Kedron, in the valley of Jehoshaphat, to the more touching and endearing spots of the Garden of Gethsemane, the Rock of Calvary, and the sepulchre in which the body of our Lord was laid.

While these were the objects of my inspection in Egypt, Arabia, and Palestine, the Scriptural countries of Syria and Mesopotamia were scarcely less prolific in the abundance of the materials which they presented to my view. In the former were the sea-ports of Berytus, Byblus, Tripolis, and Laodicea, with the great interior cities of Antioch on the verdant banks of the Orontes, Aleppo on the plains, and the enchanting city of Damascus, whose loveliness has been the theme of universal admiration, from the days of Abraham and Eliezer to those of Naaman the Syrian, and the great Apostle of the Gentiles, and from thence to the present hour: while the great Temple of the Sun at Baalbeck, the splendid ruins of Palmyra, the gorgeous monuments of ancient splendor in the Roman settlements of Decapolis, and the still earlier dominions of those who reigned before either Greek or Roman in Bashan and Gilead, and the regions beyond Jordan, added splendor to beauty, and combined all that the traveller or antiquary could desire.

Mesopotamia, including the ancient empires of Chaldea, Assyria, and Babylonia, into which I passed from Palestine, largely rewarded my researches. In the former, the celebrated city of Ur of the Chaldees received me within its gates, and I passed many days in this ancient birth-place and abode of the patriarch Abraham. The extensive ruins of Nineveh, spread in silent desolation along the banks of the Tigris, and the fallen Babylon, stretching its solitary heaps on either side of the great river Euphrates, were also objects of patient and careful examination; as well as the Oriental capital of the Caliphs, Bagdad the renowned; and the remains of the great Tower of Babel, on the plain of Shinar, of which a considerable portion still exists to attest the arrogance and folly of its builders.

Media and Persia came next in the order of my wanderings; and there, also, the ruins of the ancient Ecbatana, the tomb of Cyrus at Pasagarda, and the splendid remains of the great temple at Persepolis, gratified in a high degree the monumental and antiquarian taste; while the populous cities of Kermanshah, Ispahan, and Shiraz, with the lovely valleys of Persian landscape, amply fed my love of the beautiful and the picturesque.

In India, as the field was more extended, and the time devoted longer by several years, far more was seen, experienced, and felt. It may suffice, however, to say, that all the outlines of that magnificent 'Empire of the Sun,' from the Red Sea and the Persian Gulf on the west, to the Bay of Bengal on the east, were traced by my voyages along its shores; for after navigating, and accurately surveying both the seas named, from Suez to Bab-el-mandeb in the one, and from the mouth of the Euphrates to the port of Muscat in the other, I visited Bombay, and all the ports upon the coast of Malabar; from thence to Colombo and Point de Galle in the Island of Ceylon; afterwards anchored at Madras, and entered the ports of Bimlipatam and Vizagapatam, on the coast of Coromandel and Orissa, in the region of the Idol temple of Juggernaut; and ultimately reached the British capital of India, Calcutta, on the banks of the Ganges.

It may readily be conceived that in so extensive and varied a track as this, the personal adventures I experienced were as varied as they were numerous; and I may assert, with confidence, that while privation and suffering had been endured by me in almost every form — in hunger, thirst, nakedness, imprisonment, shipwreck, battle, and disease — so also, every pomp and pleasure that man could enjoy, from honors bestowed, and hospitalities received, agreeably relieved the tedium of my way; so that although my course was not invariably on a bed of roses, neither was it always across a path of thorns.

Amid all these changes, however, there was one thing which, in me at least, remained happily the same. No length of travel, no amount of suffering, no blandishments of pleasure, no intimidations of tyranny, no debilitation of climate, no variety of institutions, had been sufficient to abate in me, in the slightest degree, that ardor of attachment to Liberty, civil, political, and religious, which God and Nature implanted in my breast from the cradle—which experience fanned into maturity with manhood—and which Providence, I trust, will keep alive in my heart to the latest period of my advancing age. Animated by this love of Liberty, which you, the people of America, as you know how to cherish among yourselves, will not be disposed to condemn in others, I continued, even under the burning clime and despotic rule of an Eastern tyranny, to think, to feel, and to speak, as every Englishman, proud of his country, his ancestors, and his laws, ought to do, so long as he bears that honored name. For thus presuming to carry with me from the land of my fathers that spirit, which made England for so many years the Hope of the world, and which, infused into the early settlers of your own still freer country, and continued in their proud posterity, makes it now the Asylum and the Home of the Oppressed; for this, and for this alone, I was banished by a summary and arbitrary decree, without trial, hearing, or defence; my property destroyed, to the extent of not less than two hundred thousand dollars, and the prospective certainty of another two hundred thousand dollars at least cut off, and annihilated at a single blow.

With the details of this atrocity it is not my purpose or intention to trouble you; but while I record the fact, as one which forms an important link in the chain of circumstances that impel me hither, I may add, that the almost universal indignation of the people of England has been expressed against this gross injustice — that a Parliamentary Committee, composed of men of all parties in politics, unanimously pronounced its condemnation—and that the highest authorities among our public men have expressed their abhorrence of the deed; but from the impunity enjoyed by the East India Company in their oppressions abroad, and the impossibility of making them subject to our legal jurisdiction at home, no redress has, to this hour, been obtained, nor, according to all human probability, is any ever likely to be procured.

From the period of my arbitrary and unjust banishment from India, up to the reform of our Parliament in England, I was incessantly and successfully engaged in directing the attention of my countrymen to the evils of the East India Monopoly, and enlisting their interests and their sympathies in demanding its extinction. With this view I was occupied about six years in addressing the British public through the pages of the 'Oriental Herald,' and four years in a patriotic pilgrimage through England, Scotland, and Ireland, on a crusade against the abominations of the East; in the course of which I traversed all parts of the three divisions of our kingdom, visited almost every town of the least importance in each, and addressed, in public speeches, lectures, and discourses, on this important subject, not less than a million of my assembled countrymen, in audiences varying from five hundred to two thousand each, including persons of all ranks, from the peasant to the peer, of both sexes, of every age, and of every political and religious persuasion.

The result of all this was the kindling a flame throughout the entire nation, which burnt brighter and brighter as the hour of consummation approached, and at length became perfectly irresistible. More than an hundred provincial associations were formed, among which Liverpool, Manchester, Leeds, Glasgow and Birmingham took the lead, to demand the abolition of the East India Company's commercial monopoly, and the amelioration of its civil government; and not less than 100,000*l*. was raised and expended in the legitimate promotion of this object, through public meetings, deputations, and the powerful agency of the press.

The reform of Parliament being accomplished, I was invited, under circumstances of the most flattering nature to myself, but on which I will not dwell, to become the representative of the town of Sheffield, in which, and to which, I was then personally an entire stranger, but its invitation was founded on a knowledge of my public life and labors alone. I was successfully returned to the first reformed Parliament as its member, and had the happiness to advocate, in my place, in the British House of Commons, the views I had maintained in India—for maintaining which, indeed, I was banished from that country — and which I had since, by the exercise of my pen and tongue, for ten years, spread so extensively in England. The triumph of these principles was at length completed by the accomplishment of all my views. The India monopoly was abolished, and free trade to India and China secured. The liberty of the press in India was established, and trial by jury guaranteed. The political as well as the commercial powers of the East India Company were curtailed. The horrid and murderous practice of burning the widows of India alive on the funeral piles of their husbands was put down by law. The blood-stained revenue derived from the idolatrous worship of Juggernaut was suppressed. The foundation of schools — the promotion of missions— the administration of justice — were all more amply provided for than before — and to me, the sufferings and anxieties of many years of peril and labor combined, were amply rewarded by the legal and constitutional accomplishment of almost every object for which I had contended, and the gratification of almost every wish that I had so long indulged.

In addition to my ordinary share in the duties of the Senate, I had the happiness to be the favored instrument of first bringing before it the great question of Temperance; and through the investigations of a Committee, I had the satisfaction of presenting to the world such a body of evidence and so demonstrative a Report, as to convince a large portion of the British nation, that it was their solemn duty to God and man, to follow their American brethren in the noble example which they were the first to set in this most important branch of Moral and Social Reform.

Of the remainder of my labors as a member of the British Legislature, it is not necessary that I should speak: but I may perhaps, without presumption, be permitted to add — and there are happily now in the city of New-York some of the most intimate and influential of my constituents among the merchants and manufacturers of Sheffield, who can confirm the statement — that I had the happiness to sit as the representative of that large and opulent town for a period of six years, in the enjoyment of as much of the confidence and approbation of its inhabitants as it was possible for any representative to be honored with; and that in every annual visit made to my constituents, for the purpose of giving them an account of my stewardship in Parliament, and surrendering up my trust to the hands of those who first bestowed it on me, I was uniformly crowned with the testimony of their unanimous approbation, and sent back to the House of Commons as their Representative, with, if possible, still more unlimited confidence than before.

The period came, however, in which it was necessary, for the interests of those who are dear to me by blood and family ties, and for whom it is my duty as it is my happiness to provide, that I should quit my senatorial duties, and after nearly thirty years devoted to the service of the public, at a sacrifice of ease, fortune, leisure, domestic enjoyment, and indeed every thing but honor and character, that I should resign my trust to some more fortunate successor, and devote the few remaining years of health and activity, that might be spared me, before old age should render exertion impracticable, to providing a retreat for the winter of life, and acquiring the means of making that retreat independent as well as honorable. I accordingly announced this intention, and the reasons on which it was grounded, and at the close of the last session of Parliament in July, 1837, I paid a farewell visit to my constituents at Sheffield, where, though all our previous meetings had been cordial, hearty, and affectionate in the extreme, this was more cordial, more affectionate — though tinged with a new element of sorrow and regret — than any that had gone before.

These, then, are the circumstances, and I have narrated them with as much brevity as possible, which have led me to quit the land of my nativity, and go, with my family, to other shores. The motives which have induced me to prefer those of the United States, as the first, at least, to be visited in my course, and the objects which I hope to accomplish among you, still require to be explained.

It is an opinion, not now professed by me for the first time, but long entertained, and frequently avowed, that America is destined, in the course of time, to be the great centre of Freedom, Civilization, and Religion, and thus to be the Regenerator of the World. In the ages that are passed, we have seen the rays of science and the beams of truth first illumining the countries of the East, and then passing onward, like the light of Heaven itself, progressively toward the West:— Chaldea giving knowledge to Egypt — Egypt to Greece — Greece to Rome — Rome to Iberia, Gaul, and Britain — and these three in succession to their respective settlements in America; — till these last, shaking off their dependance, and rising in the full dignity of their united strength, asserted and secured their freedom, and took their place among the most enlightened and most honored nations of the earth.

From that moment you have gone on, rejoicing like the sun in his course, increasing in population, in commerce, in liberty, in wealth, in intelligence, in happiness, till your people have penetrated the primeval forests, and spread themselves as cultivators of the soil from the Atlantic almost to the Pacific, till your ships cover every sea, and till the Message of your President, unfolding the measures of the past, and developing the prospects of the future, is looked for with interest at every court in Europe, and read with eager and intense attention by the humblest lover of freedom in every country in which it is made public.

Commanding, therefore, as you now do, a position the most favorable to national greatness, to useful influence, and to honorable renown; the vast interior of your extensive surface embracing every variety of climate, soil, and production, and your extended sea-coasts furnishing ports of attraction to all the world; with the Atlantic Ocean for your highway to Europe, and the Pacific for your approach to Asia; your mighty rivers, rising cities, populous villages, increasing colleges, temples of public worship, and adult and infant schools; what is wanting, but time, to place you at the head of those nations of the old world, who, less than a century ago, derided your intelligence and your strength, to both of which you have long since compelled them to pay the homage that was justly due?

While others, therefore, visit your shores, charged either with merchandise to sell, or gold and silver to buy, I venture to come among you, freighted with no cargo of goods for your consumption, or with the precious metals for purchase or exchange. In the midst, however, of all the bustle and animation that fills your crowded marts, there will be room, I hope, for one who brings only the knowledge and experience acquired by years of travel in the Scriptural and Classical countries of the East, to communicate to those who may have leisure and disposition to hear, and taste and education to enjoy, whatever can illustrate the history and poetry of early days; and above all, whatever can tend to unfold the beauties, confirm the prophecies, and give strength and force to the sublime and important truths contained in the Sacred Volume of our common faith.

This is the first object which I hope to accomplish by my sojourn among you, and this alone would well justify my visit to your shores. If, at the same time, there be others not incompatible with this prominent one, but auxiliary and subordinate to it, that I may be permitted to pursue — such as a careful and impartial examination of your own resources, institutions, literature, and manners — so that while diffusing information for the gratification of others, I may be adding to my stores of knowledge for my own delight, I doubt not that I shall find among you all the kindness of aid for which you have so long been renowned.

The mode that I have chosen for the communication of the interesting details with which the past history and actual condition of the Scriptural and Classical countries of the East abound, namely, that of oral discourses, or extemporaneous lectures, may appear to some to be less dignified, as it is undoubtedly less usual, than the diffusion of this class of information through printed books. But it may be defended, first, on the ground of its greater practical utility, being at once more attractive and more efficient; and secondly, on the ground of its high antiquity, and of the sacred and classical, as well as noble and historical precedents in its favor.

As to the ground of its attractiveness, it has been found, in Britain at least, that thousands would be induced to assemble to *hear* a traveller personally narrate his adventures, and describe the objects he has seen, where it would have been difficult to get even hundreds to bestow the time and labor of *reading* the same things in printed books; and when I add that in London, Edinburgh, Dublin, Glasgow, Belfast, Liverpool, Manchester, Leeds, Birmingham, Sheffield, Hull, Bristol, Bath, and others of our largest and most intellectual cities, audiences increasing from five hundred to two thousand persons have been attracted for six successive nights, without apparent inconvenience or fatigue — the proof of the superior attractiveness of spoken discourses, over printed books, may be considered as complete. Of their superior efficiency there is even still less doubt; for the very fact of so many persons being assembled together at the same time, and hearing the same observations at the same moment, excites an animation, sympathy and enthusiasm, which is contagious in its effects on both speaker and hearers, till their feelings flow in one common current; the facts sink deeper into the memory at the time, and the subsequent conversation, criticism, comparison, and reflection, to which this gives rise among those who attend, implant them with a firmness that no amount of mere reading could accomplish.

For precedents or authorities, it is not necessary to go far in search, so profusely do they abound in ancient and in modern annals. In Scriptural ages, the oral mode of communication was almost the only one in use, from the days of Abraham, who, according to the testimony of Josephus, thus taught the Chaldean science of Astronomy to the Egyptians — down to the time of Solomon — who discoursed so eloquently of the productions of Nature in the animal and vegetable kingdoms, and from whose lips the profoundest maxims of wisdom were poured into charmed ears — and from thence again to the days of Paul, who stood before Festus, Felix, and Agrippa, at Cesarea; and who, clothed in all the majesty of Truth, addressed assembled thousands at Antioch, at Ephesus, at Athens, at Corinth, and in Rome.

In classical countries the custom was universal, and there are many who conceive, with the great Lord Bacon, that one of the causes of the superior intellect of the Greeks, was the method in use among them of communicating knowledge by oral discourses, rather than by written books, when the pupils or disciples of Socrates, of Plato, and of Epicurus, received their information from these great masters, in the gardens and the porticos of Athens, or when the hearers of Demosthenes, of Eschylus, of Sophocles, or Euripides, hung with rapture on their glowing sentences, as pronounced in the Areopagus — the theatre — the gymnasium — or the grove.

Of classical authorities, the memorable instance of Herodotus will occur to every mind. This venerable Father of History, as he is often called, having been first banished from his native country Halicarnassus, under the tyranny of Lygdamis, travelled, during his exile, through Egypt, Palestine, Syria, Mesopotamia, and to the borders of Media and Persia, in which he was engaged for several years. On his return from his travels he was instrumental in uprooting and destroying the very tyranny under which his banishment took place; but this patriotic deed, instead of gaining for him the esteem and admiration of the populace, who had so largely benefitted by his labors, excited their envy and ill-will; so that he a second time left his native land, and then visited Greece. It was there, at the great festival of the Olympic Games, about five hundred years before the Christian era, being then in the fortieth year of his age, that he stood up among assembled myriads of the most intellectual auditors of the ancient world, to narrate, in oral discourses, drawn from the recollection of his personal travels, the subject matter of his interesting history and description of the Countries of the East; and such was its effect upon the generous hearts and brilliant intellects of his accomplished hearers, that while the celebrated Thucydides, then among them as a boy, shed tears at the recital of the events of the Persian war, and his young bosom was perhaps then first fired with the ambition which made him afterwards one of the most accomplished historians of Greece, the people received Herodotus with such universal applause, that as an honor of the highest kind, the names of the nine Muses were bestowed upon the nine Books or subdivisions of his interesting narrative, which they continue to bear to the present hour in every language into which they have been translated.

Pythagoras, of Samos, is another striking instance of a similar career. Disgusted with the tyranny of Polycrates, he retired from his native island; and having previously travelled extensively in Chaldea and Egypt, and probably in India, he also appeared at the Olympic games of Greece, and travelled through Italy and Magna-Grecia, delivering, in the several towns that he visited, oral discourses on the history, religion, manners, and philosophy of the Countries of the East; and their general effect was not less happy than that produced by the narrations of Herodotus; for it is said that 'these animated harangues were attended with rapid success, and a reformation soon took place in the life and morals of the people.'

I might go on to enlarge the catalogue of precedents, for both ancient and modern history is full of them — Marco Polo, Columbus, Camoens, Raleigh, and Bruce (all, too, treated with the deepest injustice by their countrymen) will occur to every one — but it is unnecessary. May I only venture to hope, that as some similarity exists between my own history and sufferings from tyranny and the ingratitude of contemporaries and that which marked the career of those great men whose names I have cited — Herodotus and Pythagoras — as well as in the countries we each traversed, and the mode of diffusing the information thus acquired by oral discourses among the people of other lands — the similarity may be happily continued — if not in the honors to be acquired, at least in the amount of the good to be done; and that in this last respect, the Olympia and Magna Grecia of the East may fairly yield the palm to the more free and more generally intelligent Columbia of the West, is my most earnest hope and desire, my most sincere and fervent prayer.

I will say no more, except to add, that should my humble labors among you be crowned with the success which I venture to anticipate, and should Providence spare me life and health to follow out the plan I have long meditated and designed, it is my intention, after visiting every part of the United States of America, to extend my tour through the British Possessions of Canada, New-Brunswick, Nova Scotia, and the West Indies; to visit from thence the Isthmus of Darien, for the purpose of investigating this barrier between the Atlantic and Pacific Ocean; to make an excursion through Mexico, and from thence pass onward by the South Sea Islands to China, visit the Phillippines and the Moluccas, go onward to Australia and Van Dieman's Land; continue from thence through the Indian Archipelago, by Borneo, Java, Sumatra, and Malacca, to India; traverse the Peninsula of Hindoostan, from the Ganges to the Indus, and return to Europe by the Red Sea and the Mediterranean.

Throughout the whole of this long and varied route, there are a few prominent and important objects, which, as they have been long favorite subjects of study, and have engaged a large share of my attention in the past, I shall hope to keep steadily in view, and do all within my power to advance in the future. It has long been my conviction, that among the most prolific causes of vice and misery in the world, those of Intemperance, Ignorance, Cruelty, and War, are productive of the greatest evils; and that the best service which man can render to his fellow-beings is therefore to promote, by every means within his reach, the principles and practice of Temperance, Education, Benevolence, and Peace. My belief is, that more of sympathy and cordiality in favor of these great objects will be found in the United States of America, than in any other country on the globe. Already, indeed, has she done more than any other country that can be named for the advancement of Temperance, the spread of Education, the amelioration of the Criminal code, the improvement of prisons and penitentiaries, and the practical illustrations of the blessings of Peace. And placed as she now is, between the two great Seas that divide the old from the new world, and separate the ancient empires of the East from the modern nations of the West,—so that with her face toward the regions of the sun, she can stretch out her right hand to Asia and her left hand to Europe, and cause her moral influence to be felt from Constantinople to Canton—she has the means within her reach, as well as the disposition to use those means, for the still further propagation and promotion of her benevolent designs. It is this which encourages me to believe that my ulterior projects and intentions, which I thus freely avow, will not lessen the cordiality with which the first and more immediate object of my mission to your shores will be received. The land now covered with the descendants of the Pilgrim Fathers, and the offspring of those noble and unyielding spirits, who, fleeing to the uncleared wilderness as a refuge from tyranny and persecution, found in its primeval forests the liberty they in vain sought for in their native homes, and whose posterity, while filling these forests with cities, and covering the wilds with civilization and religion, have never forgotten those lessons of Freedom which their ancestors first taught by their practical privations and sufferings, and then sealed and cemented by their blood — such a land is not likely to refuse its shelter to one whose past history may give him some claim to the sympathy of its possessors, whose present labors may be productive of intellectual gratification to themselves, and whose future undertakings, if blessed by Divine Providence, may sow the seeds, at least, of benefit to other widely-scattered regions of the earth.

To you, then, the People of America, I frankly submit this appeal: and at your hands I doubt not I shall experience that cordial and friendly reception which may smooth the ruggedness of a Pilgrim's path, and sooth the pillow of an Exile's repose.

J. S. BUCKINGHAM.

THE

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# SCIENCE AND ARTS.

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CONDUCTED BY

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# ERRATA.

P. 200, 5th line fr. bot. after *presiding*, read *over the Math. and Phys. Section.*—P. 207, 4th line fr. top, for 1837, read 1835.—P. 216, 4th line from bot. for *Paracels*, read *Pratas.*—P. 325, last line, for *commenced*, read *enumerated.*—P. 374, 6th line from bot. for *It it*, read *It is.*—P. 400, 13th line from bot. for *Moranies*, read *Moraines*.

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*Fossils of the Medial Tertiary of the United States*, by *Mr. T. A. Conrad.*—Mr. Dobson of Philadelphia, in a letter dated Dec. 31, 1838, (received after our present number was printed,) announces that he has published the first part of this new work of Mr. Conrad. It will be completed in about 15 months, in 3 parts. The first No. contains 17 plates, and 47 species. He will again visit the Tertiary region, and give a detailed description of the various localities in a future number. The price of the whole, will be $ 4 50.

## ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

*Remarks.*—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from us, that we may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still our endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, in part, retrospective.—*Eds.*

### SCIENCE.

### *Foreign.*

Remarks on the Mineralogy and Geology of Nova Scotia, by Abraham Gesner, Surgeon, Halifax, 1836. From Neville Parker, Esq.

Transactions of the Literary and Historical Society of Quebec, Vol. III, Part IV. From the Society.

Address of the Duke of Sussex, before the Royal Society, London, Nov. 30, 1837. From Wm. Vaughan, Esq., London.

Researches on Heat, by Prof. J. D. Forbes, Edinburgh. Third series. From the Author. Forwarded by the kindness of Mr. Vaughan.

The ninth Bridgewater Treatise, by Chas. Babbage, Esq. Second edition. London, J. Murray, Albermarle st., 1838. From the Author.

Icones Plantarum: figures and descriptions of new or rare plants, by Sir William Jackson Hooker, K. H. London, 1838. From the Author. Part IV.

Kongl.-Vetenskaps-Academiens Handlingar För Ar 1836. Stockholm, 1838. From Jac. Berzelius, K. V. A. Secret.

Arsberättelse om Framstegen i Fysik och Kemi, Mart. 1836, af Jac Berzelius. Stockholm, 1836. From the Author.

——— om Technologien, 1836, af G. E. Pasch. Stockholm, 1836. From Prof. Berzelius.

——— om Zoologiska Arbeten, 31 Mart. 1835 och 1836, af B. Fr. Fries. Stockholm, 1837. Prof. Berzelius.

——— om Botaniska Arbeten och upptäckter. För Ar 1835, af Joh. Em. Wikström. Stockholm, 1837. Prof. Berzelius.

——— om Hydraulikens, af P. Lagerhjelm. Stockholm, 1837. Prof. Berzelius.

Arsberättelse i Astronomien af S. A. Constrand. Den 31 Mart. 1836.

Elements of Geology, by Charles Lyell, Esq., F. R. S. London, 1838. From the Author.

The Fifth Annual Report of the Royal Cornwall Polytechnic Society, 1837. Falmouth. From the Society.

The Logs of the first voyage of the Great Western, Steam Ship. Bristol, 1838. Two copies. From Mr. S. Luckie.

Phillips' Introduction to Mineralogy, by Robert Allan. Fourth Edition. London, 1837.

### *Domestic.*

Holbrook's North American Herpetology. Two vols. quarto—plates. Dobson, Philadelphia.

Treatise on Gems, by Dr. Lewis Feuchtwanger. New York, 1338. From the Author.

Transactions of the American Philosophical Society, Vol. VI, new series. Phila. 1838. Kay & Brother. From the Society.

The same, from Isaac Lea, Esq., containing his observations on the Genus Unio, with descriptions of new genera and species in the family Naiades, &c.

Report on the George's Creek Coal and Iron Company's lands, with a description and drawings of part of the Cumberland Coal Basin, 1836. From the Authors.

Olmsted's Natural Philosophy, 2d edititon, enlarged. 2 vols. 8vo., New Haven, 1838. From the Author.

American Almanac, Vol. X, Boston, 1839. From J. E. Worcester, Esq., Editor.

Analysis of the Mineral Waters of Avon, N. Y., 1838, several copies. From Dr. Salisbury.

On the influence of Caloric on the living Animal Body, by Robert Peter, M. D. From the Author.

Report of the Committee on Naval Affairs, on the Project of Dr. H. H. Sherwood, for determining Latitude and Longitude by the Variation and Dip of the Magnetic Needle. From Hon. N. P. Tallmadge—another from Hon. J. Davis.

The Cultivator, for 1838. From Hon. Judge Buel, Editor.

The Annual Report of the Water Commissioners, New York, 1838. From Mr. Redfield.

Catalogue of Plants found in the vicinity of Milwaukie, Wisconsin. From J. A. Lapham, Author.

Faith the life of Science—an Address before the *Φ. Β. Κ.* of Union College, by Taylor Lewis, Albany. From the Society.

Transactions of the American Philosophical Society, Phila. Historical and Literary, Vol. VII, Du Ponceau on Chinese Writing. From the Author.

Liquefaction and Solidification of Carbonic Acid, by and from J. K. Mitchell, M. D.

Report of Prof. Shepard on the Missouri Iron Mountains. Author.

First and Second Reports of the progress of the Geological Survey of the State of Virginia for the years 1836–7, by Prof. Wm. B. Rogers. From the Author.

Report on the Geological Survey of the State of New Jersey, second edition, by Prof. Henry D. Rogers. From the Author. Philad. 1836.

Catalogue of Philosophical and Chemical Apparatus for sale by Joseph Wightman, 33 Cornhill, Boston. From Mr. J. Wightman.

Mr. Pickering's Eulogy on Dr. Bowditch. Two copies, one for the Connecticut Academy. From Mr. Pickering. Boston, 1838.

Map of Florida. From Col, Whiting, Detroit.

Observations on the Le Motte Mines and Domaine in Missouri. Washington, 1838. From Forrest Shepherd.

Manual of Conchology, by Thos. Wyatt, M. A.—Many plates. Philad. 1838. From the Author.

Monography of the family Unionidae, or Naiades of Lamarck, by T. A. Conrad. Nos 8, 10, 11, two copies in exchange. From Mr. Dobson, publisher.

The Science of Geology, from the Glasgow Treatises, with additions. First American edition. New Haven, 1838. B. & W. Noyes. 3 copies, (two from the publishers, one from W. C. R.)

Prof. Shepard's Address before the Horticultural Society in New Haven. From the Author.

## MISCELLANEOUS.

### *Foreign.*

Annual Report of the Morrison Education Society, Canton, China, 1838. From Dr. Parker.

Seventh Quarterly Report of the Ophthalmic Hospital at Canton, by Rev. P. Parker, M. D. From the Author.

Medical Missionary Society in China. From Dr. Parker.

Laborer's Friend, London, No. 71. From William Vaughan, Esq.

Constitution and By Laws of the Sandwich Island Institute, 1838. Rev. J. Diell.

Annual Report of the Canada Sunday School Union.

### *Domestic.*

Catalogue of Officers and Students of Wabash College.

" " " Harvard Univer., 1838–9. S. F. Plimpton.

Catalogue of the Collegiate Department of the University of Pennsylvania, Philad. Prof. Parkes.

Catalogue of Columbia College, New York, from 1758 to 1836. Prof. Renwick.

Catalogue of Dartmouth College for 1838–9. Hanover, N. H. Dr. Lord.

Catalogue of New Hampshire Medical Institution, Dart. Coll., for 1838. Prof. Hubbard.

Catalogue of the Theological Department in Yale College, 1838.

" of the Western Reserve College for 1838–9. From Prof. Loomis. Two copies.

Thirteenth Annual Report of the Prison Discipline Society. Boston, 1828.

Annual Circular of the Medical College of Louisiana of 1839.

Annual Commencement of Jefferson Medical College, Philadelphia, for 1838–9.

Present State and Condition of the Free People of Color of Philadelphia, 1838. J. Vaughan, Esq.

Charter of the Electro-Magnetic Company.

History of the Controversy in N. Y. University, by the Professors and Faculty. From Mr. Elliott.

A Letter to the Chancellors of the University of the City of New York. From the Professors.

Home Mission Society. 12th Annual Report. From the Soc.

American Bible Society. 22d Annual Report.

Letter to the Willard Association of Troy, N. Y., by and from Mrs. Willard.

Report of the Executive Committee of the American Temperance Union, 1838, Philad. From Rev. J. Marsh.

Refutation of Charges made by Dr. Caldwell against Prof. J. C. Cross. From the Author.

Twenty second Report of the Directors of the Deaf and Dumb Asylum at Hartford, Conn. 1838.

Message from the Governor to the General Assembly of Pennsylvania. Harrisburg, 1838. From Gov. Ritner.

Sachem's Wood, a poem, by J. A. Hillhouse. Author.

Thos. Williams' Centennial Sermon, preached 1836. From Mr. Williams.

Christian Examiner and General Review, No. 87, July, 1838, containing a notice of Geological Surveys.

Medical Education, and Address before the Medical Society of Tennessee, by Dr. Yandell. From the Author.

Report of the First American Fair at Cincinnati, Ohio, with an Address by E. D. Mansfield. From Mr. Mansfield.

Internal Improvements in the State of N. York, by H. O'Reilly.

An Address before the Cuverian Society of Wesleyan University, Middletown, Conn., by Prof. William H. Allen. From the Author.

Report of F. R. Hassler, Superintendent of the fabrication of Standard Weights and Measures. Senate, No. 500. Two copies, from Mr. Hassler.

Report of F. R. Hassler, Superintendent of the Coast Survey, Senate, No. 79. From Mr. H. 2 copies.

## SPECIMENS.

A box of Peat Earth. From Rev. H. Linsley, Stratford.

A small box of African Shells. From Dr. Savage, of Middletown.

A box of Minerals, casts of Ornithichnites, and Peat. From Prof. Hitchcock, Amherst, Mass.

A mass of Mineral Tar, from the bitumen lake, Trinidad. From Dr. Van Buren, Trinidad, by the hands of Dr. Hooker.

Botanical and other specimens, illustrative of the Natural History of Florida. From Col. Whiting.

A box of fresh water Shells, for the Yale Natural Hist. Society. From Mrs. L. W. Say, New York.

## NEWSPAPERS.

### *Domestic.*

Daily Buffalo Journal. No. 770. Contains Mr. J. S. Buckingham's verses on Niagara.

New York Sun. July 13th, 1838. "*Antiquities unearthed.*" C. J. Lynde.

The Country Advertiser. Petersburg, Va. Several Nos.

Elizabethtown Republican. Jan. 2, 1838.

Connecticut Common School Journal. Nos. 1 to 6. H. Barnard, Esq. Hartford.

Louisville Gazette. Eight Nos.; containing geological notices by J. W.

New York Common School Annual.

Daily Chronicle. Augusta, Ga. No. 170. J. H. Plant.

New York Transcript. Vol. 7. No. 111. Mr. Holebrook's system of education.

Several papers on the affairs of the New York University. From G. S. Silliman, Esq.

Albany Daily Advertiser. July 4th, 1838. Lines on 4th of July. From J. S. Buckingham, Esq. Eng.

Boston Patriot. August 25th, 1838. Eclipse of the sun.

Troy Daily Morning Mail. No. 319.

Genesee Farmer. Rochester, N. Y. No. 41, Vol. 8. W. Gaylord.

Boston Mercantile Journal. Vol. 6, No. 28. N. Capen.

Buffalo Commercial Advertiser. Aug. 1st. 1831. Contains a notice of this Journal.—Also Daily Journal, with notice of aurora of 13th of Sept. and following nights.

Buffalo Patriot and Commercial Advertiser. Nov. 28, 1838. With notice of Am. Journal. Vol. 35, No. 1.

Do. do do. do. Dec. 15. With a notice of diluvial scratches.

The same, of Dec. 24th. With extracts of proceeding of the French Academy.

The same, of Dec. 27th. With do. do. The above five all from Mr. R. W. Haskins.

Harrisburg Chronicle, of Dec. 5th, 1838. No. 55. Do. No. 59. The Keystone, of Dec. 7th. Pennsylvania Telegraph, extra, Dec. 6: all from Mr. N. Ellmaker; containing accounts of the recent proceedings at Harrisburg, with the proclamation of the governor of Pennsylvania.

The Temperance Herald. Providence. Dec. 6th, 1838.

Mississippi Free Trader, of Nov. 22d, 1838. Containing a letter on the properties of Jussieua grandiflora, by and from Dr. Cartwright of Natchez.

Phil. National Intelligencer, Dec. 27th, 1828. Notice of working iron by anthracite coal. From J. W. Robinson.

Farmer's Register, with Dr. Armstrong's Agricultural Address. No. 9. 1838.

Christian Statesman. Washington. Dec. 21st, 1838. Meeting of the American Colonization Society. From R. Gurley.

Daily Courant. Hartford. Dec. 18th, 1838. Notice of Mr. J. A. Hillhouse's lecture. From Mr. H. Barnard.

Boston Independent Chronicle and Patriot. Jan. 5th, 1839. Extraordinary height of barometer. $31\frac{1}{10}$ inches on Tuesday, Jan. 1st, 1839.

## *Foreign.*

London Athenæum. Nos. 565-6-7-8. British Association of August, 1838. Received from Rev. Samuel Wood, Canterbury. England.

Montreal Morning Courier. Nov. 6th, 1838. Account of Lord Durham's departure from Canada.

London Morning Advertiser. Oct. 3d, 1838. With a notice of Mr. Richardson's geological lectures at Brighton. From Mr. Richardson.

The Publisher's Circular. Nos. 26 and 27. London. From Wiley & Putnam.

New books for sale by Wiley & Putnam.

## AMERICAN INSTITUTION FOR THE CULTIVATION OF SCIENCE.

The following Circular was received too late for insertion in the body of our present number,—we accordingly, that no time may be lost, take this method of placing it before our readers :

BOSTON, NOVEMBER 1, 1838.

IN consequence of communications between members of the AMERICAN PHILOSOPHICAL SOCIETY, in Philadelphia, and gentlemen in Boston, a meeting was held in the latter place, of gentlemen belonging to Boston, Salem, and the University at Cambridge, at which the proceedings were as follows:

His excellency, Governor Everett, was requested to take the chair.

The Hon. Francis C. Gray was chosen Secretary.

The Chairman stated the objects of the meeting.

Dr. Warren offered and explained the three following resolutions, which were eloquently supported by the Hon. Judge Story and other gentlemen, and unanimously adopted.

1. *Resolved,* That it is expedient to form an Institution to be called the AMERICAN INSTITUTION FOR THE CULTIVATION OF SCIENCE, having for its object the advancement of physical science and literature, by assembling those interested in this object at stated periods, thus effecting an interchange of discoveries and improvements between the inhabitants of different parts of the country.

2. *Resolved,* That the organization of such an Association can best be accomplished by scientific and literary persons situated in a central part of the country, and that therefore we recommend that the American Philosophical Society, in Philadelphia, be invited to undertake this organization, with the understanding that the meetings be held successively in the different great cities of the Union.

3. *Resolved,* That as frequent meetings of those here assembled might not be practicable, a Committee of Correspondence be created, whose duty it shall be to call meetings when necessary, to communicate with the American Philosophical Society and other scientific associations, and to advance the object of this meeting by all means in their power.

*Committee.*

DR. WARREN,
GOV. EVERETT,
HON. JUDGE STORY,
JOHN PICKERING, ESQ.
HON. F. C. GRAY,
DANIEL TREADWELL, ESQ.,
DR. HALE.

An account of the proceedings at this meeting is transmitted to you, with the hope of obtaining your concurrence, that of your scientific friends, and of scientific associations with which you are connected, in the prosecution of this object.

By order of the Committee of Correspondence.
JOHN C. WARREN, *Chairman.*

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

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## ART. I.—*Memoir of the Life and Character of Nathaniel Bowditch, LL. D., F. R. S.;* by Rev. ALEXANDER YOUNG.

NATHANIEL BOWDITCH was born at Salem, in the Commonwealth of Massachusetts, on the 26th day of March, 1773. He was the fourth child of Habakkuk and Mary Ingersoll Bowditch. His ancestors, for three generations, had been shipmasters, and his father, on retiring from that perilous mode of hard industry, carried on the trade of a cooper, by which he gained a scanty and precarious subsistence for a family of seven children.

I had a curiosity to trace up the life of this wonderful man, if possible, to his childhood, to ascertain his early character and powers, and the influences under which his heart and mind had been formed. Accordingly, on a recent visit to Salem, I took a walk, of some two or three miles, to see a house where he used to say that he and his mother had lived when he was as yet hardly advanced beyond infancy. My walk brought me among the pleasant farm-houses of a retired hamlet in Essex county; and I found the plain two-story house,* with but two small rooms in it, where he dwelt with his mother; and I saw the chamber-window where he said she used to sit and show him "the new moon with the old moon in her arm," and, with the poetical superstition of a sailor's wife, jingle the silver in her pocket that her husband might have good luck, and she good tidings from him, far off upon the sea. I entered that house and two others in the vicinity, and found three ancient women who knew her well, and remembered her wonderful boy. I sat down by their firesides and listened with greedy ear to the story, which they gladly told me, of that remarkable child, remarkable for his early goodness as well as for his early greatness. Their words, uttered in the plain, hearty English of the yeomanry of New England, I took down from their lips, and now give them without any alteration or improvement whatever.

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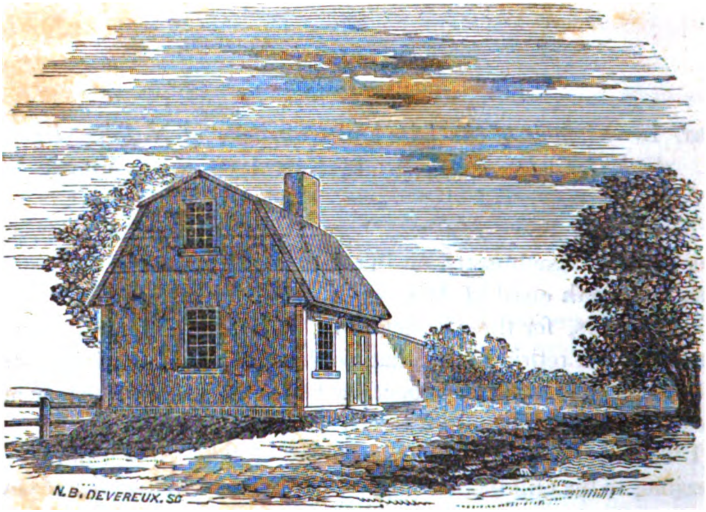
* This house is in Danvers, near the junction of several roads, this side of the Derby farm. See wood cut, next page.



The first one I interrogated said that "Nat. was a likely, clever, thoughtful boy. Learning came natural to him; and his mother used to say that he would make something or nothing." I asked her whether she had ever heard what became of him. "O yes," she replied, "he became a great man, and went to Boston, and had a mighty deal of learning." "What kind of learning?" I asked. "Why," she answered, "I believe he was a pilot, and knew how to steer all the vessels." This evidently was her simple and confused idea of "The Practical Navigator."

The second old lady stated that "Nat. went to school to her aunt, in the revolutionary war, in the house where we were then sitting, when he was about three years old, and that she took mightily to him, and that he was the best scholar she ever had.

He learnt amazing fast, for his mind was fully given to it. He did not seem like other children; he seemed better. His mother was a beautiful, nice woman."

The third old lady said that "Nat. was a little, still creature; and his mother a mighty free, good-natured woman. She used to say, 'Who should n't be cheerly if a Christian should n't?' Her children took after her, and she had a particular way of guarding them against evil."

These I testify to be their very words, as I pencilled them down at the time. And they show, I think, very clearly, the influence of the mother's mind and heart upon the character of her son. Of that mother, in after life, and to its close, he often spoke in terms of the highest admiration and the strongest affection, and in his earnest manner would say—"My mother loved me—idolized me—worshipped me."

After leaving the dame's school, the only other instruction he ever received was obtained at the schools of his native town, which were wholly inadequate to furnish even the groundwork and elements of a respectable education. I have heard it stated, on the authority of one of his schoolfellows, that the only book in their school was a dictionary, which belonged to the master, who gave out the words from it to be spelt by the boys. I have likewise been told by one who lived in Salem at the time, that the master of this school, a person of violent temper, gave young Bowditch, when he was about five or six years old, a very difficult sum in arithmetic to perform. His scholar went to his desk, and soon afterwards brought up his slate with the question solved. The master, surprised at the suddenness of his return, asked him who had been doing the sum for him; and on answering "Nobody—I did it myself," he gave him a severe chastisement for *lying*, not believing it possible that he could, of himself, without any assistance, perform so difficult a question.

But the advantages of school, such as they were, he was obliged to forego at the early age of ten years, "his poverty and not his will consenting," that he might go into his father's shop and help to support the family. He was soon, however, transferred as an apprentice to a ship-chandler, and afterwards became a clerk in a large establishment of the same kind, where he continued until he went to sea. It was whilst he was an apprentice in the ship-chandler's shop that he first manifested that strong bent, or what is commonly called an original genius, for mathematical pursuits. Every moment that he could snatch from the counter, was given to the slate. An old gentleman, who used frequently to visit the shop, said to his wife, one day, on returning home, "I never go into that shop but I see that boy ciphering and figuring away on his slate, as if his very life depended upon it; and if he goes on at this rate, as he has begun, I should not at all wonder if, at last, in the course of time, he should get to be an almanac-maker!"—this being, in his view, the summit of mathematical attainment. The expectation was speedily fulfilled, for in the year 1788, when he was only fifteen years old, he actually made an almanac for the year 1790, containing all the usual tables, calculations of the eclipses and other phenomena, and even the customary predictions of the weather. The original manuscript is still in the possession of his family.

From his earliest years, he seems to have had an ardent love of reading, and he has been heard to say that, even when quite young, he read through the whole of Chambers's Cyclopedia, in two large folio volumes, without omitting a single article.

He sailed on his first voyage, on the 11th of January, 1795, at the age of twenty-two, in the capacity of captain's clerk, on board the ship Henry, of Salem, owned by Elias Hasket Derby, Esq., and commanded by Captain Henry Prince, who still lives to glory in the fame of his clerk. Captain John Gibaut, with whom young Bowditch had been engaged the year before in taking a survey of Salem, had previously been appointed to the command of the ship, and had invited his friend to accompany him as clerk. He consented; but in consequence of some misunderstanding subsequently springing up between the owner of the ship and Captain Gibaut, he relinquished the command, and of course his agreement with his friend was at an end. Mr. Derby, however, on the appointment of Captain Prince, said to him, "Do you know young Bowditch?" "Yes, very well." "How should you like to have him go in the ship with you?" "I should like it above all things," said the captain. He accordingly went on board as clerk, although his name was entered on the shipping-papers as second mate. The ship sailed for the Isle of Bourbon, and returned home after an absence of exactly one year.

His second voyage was made as supercargo, on board the ship Astræa, of Salem, belonging to the same owner, and commanded by the same captain. The vessel sailed in March, 1796, to Lisbon, touched at Madeira, and then proceeded to Manilla, and arrived at Salem in May, 1797, after an absence of fourteen months.

At Madeira, the captain and supercargo were very politely received by Mr. Pintard, the American consul there, to whose house the ship was consigned, and were frequently invited to dine with his family. Mrs. Pintard had heard from another American shipmaster that the young supercargo was "a great calculator," and she felt a curiosity to test his capacities. Accordingly, she said to him one day at dinner, "Mr. Bowditch, I have a question which I should like to have you answer. Some years since," naming the time, "I received a legacy in Ireland. The money was there invested, and remained some time on interest; the amount was subsequently remitted to England, where the interest likewise accumulated; and lately the whole amount has been remitted to me here. What sum ought I to receive?" She of course mentioned the precise dates of the several remittances, as she went along. Mr. Bowditch laid down his knife and fork, said it was a little difficult, on account of the difference of currency and the number of the remittances; but squeezing the tips of his fingers, he said, in about two minutes, "The sum you should receive is £843 15*s*. 6¼*d*." "Well, Mr. Clerk," said Mrs. Pintard to the head clerk of the house, an elderly person, who was esteemed a very skilful accountant, "you have been figuring it out for me on paper; has he got it right?" "Yes, madam," said the clerk, taking his long calculation out of his pocket, "he has got it exactly. And I venture to say, that there is not another man on the island that can do it in two hours."

In August, 1798, he sailed in the same ship with Capt. Prince, on his third voyage, to Cadiz, thence to the Mediterranean, loaded at Alicant, and arrived at Salem in April, 1799.

On the voyage from Cadiz to Alicant, they were chased by a French privateer, and having a strong armament of nineteen guns, they prepared for action. The post assigned to Bowditch was the cabin, and his duty was to hand the powder upon deck. In the midst of the preparations for the engagement, Captain Prince had a curiosity to look into the cabin, and see whether all things were going on right there; and, to his astonishment, he found Bowditch calmly sitting at the table, with his slate and pencil, and figuring away, as usual. The thing was so ludicrous, that Captain Prince burst out a laughing, and said, "Well, Mr. Bowditch, can you be making your will now?" "Yes," was his good-natured reply. After this affair, (the French privateer having hauled off without molesting them,) the supercargo requested to be stationed at one of the guns, and his request was granted. Captain Prince testifies, that in all cases of danger, he manifested great firmness and presence of mind.

The fourth and last voyage which they made together, was in the same ship from Boston to Batavia and Manilla. They sailed in August, 1799, and returned home in September, 1800.

On their arrival at Manilla, a Scotchman, by the name of Murray, asked Captain Prince how he contrived to find the way there, through such a long, perplexing, and dangerous navigation, and in the face of the northeast monsoon, by mere dead reckoning, without the use of lunars,—it being a common notion at that time, that the Americans knew nothing about working lunar observations. Captain Prince told him that he had a crew of twelve men, every one of whom could take and work a lunar observation as well, for all practical purposes, as Sir Isaac Newton himself, were he alive. Murray was perfectly astounded at this, and actually went down to the landing-place, one Sunday morning, to see this *knowing* crew come ashore.

Mr. Bowditch was present at this conversation, and as Captain Prince says, sat "as modest as a maid," said not a word, but held his slate-pencil in his mouth. Another person on the island, a broker, by the name of Kean, who was present, said to Murray, "If you knew as much as I do about that ship Astræa, you wouldn't talk quite so glib." "Why not? what do you know about her?" "Why, sir, I know that there is more knowledge of navigation on board that ship, than there ever was in all the vessels that ever floated in Manilla Bay."

The knowledge which these common sailors had acquired of navigation, had been imparted to them by the kindness of Mr. Bowditch. Captain Prince relates that one day the supercargo said to him, "Come, Captain, let us go forward and see what the sailors are talking about, under the lee of the long-boat." They went forward, accordingly, and the Captain was surprised to find the sailors, instead of spinning their long yarns, earnestly engaged with book, slate and pencil, and discussing the high matters of tangents and secants, altitudes, dip, and refraction. Two of them, in particular, were very zealously disputing, one of them calling out to the other, "Well, Jack, what have you got?" "I've got the *sine*," was the answer. "But that an't right," said the other. "*I* say it is the *cosine*."

Captain Prince says, that although Mr. Bowditch had such a thorough knowledge of navigation, he knew but little about what is technically called *seamanship*. He also mentions the fact, which he had often heard him repeat, that although, in his youth, he had long lived in the vicinity of the ship-yards, he had never seen a launch; and rather scouted the idea that such a sight, or any thing like it, should be able to draw him away from his books. Captain Prince likewise testifies that during the whole course of these four voyages, he does not recollect the slightest interruption of harmony and good feeling between them.

I am happy to be able to corroborate the statements of Captain Prince, by the testimony of an officer in our navy, who sailed in the Astræa the two last voyages to Alicant and Batavia. In a letter recently written, after speaking in terms of the warmest gratitude of the kindness and attention with which Mr. Bowditch treated him, when a poor sea-sick cabin-boy, and acknowledging his great obligations to him for instructing him in navigation, he goes on to say that it was Mr. Bowditch's practice to interest himself in all the sailors on board, and to take pains to instruct all who could read and write, in the principles of navigation. The consequence of this was, that every one of a crew of twelve men, who could read and write, subsequently rose to the rank of captain or chief mate of a ship. Indeed, at Salem, it was considered the highest recommendation of a seaman, that he had sailed in the same ship with Mr. Bowditch, and this circumstance alone was often sufficient to procure for him an officer's berth. In illustration of this statement, he mentions the fact that on his second voyage, the first and second mates had been sailors in the same ship on the previous voyage. He also speaks of Mr. Bowditch's urbane and gentlemanly deportment to every one on board, and says that he never appeared so happy as when he could inspire the sailor with a proper sense of his individual importance, and of the talents he possessed, and might call into action.

Some idea of the extent to which a knowledge of navigation was diffused among the seamen of Salem, chiefly by the influence of Mr. Bowditch, may be gained from the following nautical anecdote which is contained in the fourth volume of Baron von Zach's "*Correspondance Astronomique,*" page 62. The Baron is relating the sensation caused at Genoa, by the arrival there, in 1817, of that splendid packet, the "Cleopatra's Barge," owned by George Crowninshield, Esq. of Salem. He says that he went on board with all the world, "and it happened," to use his own words, "that in inquiring after my friends and correspondents at Philadelphia and Boston, I mentioned, among others, the name of Mr. Bowditch. 'He is a friend of our family and our neighbor at Salem,' replied the captain, a smart, little old man, 'and that young man whom you see there, my son, was his pupil; in fact, it is he, and not myself, who navigates the ship. Question him a little, and see if he has learnt any thing.' Our dialogue was as follows:—'You have had an excellent teacher of navigation, young man; and you could not well help being a good scholar. In making the Straits of Gibraltar, what was the error in your reckoning?' The young man replied, 'Six miles.' 'You must then have got your longitude very accurately; how did you get it?' 'First by our chronometers, and afterwards by lunar distances.' 'What! do you know how to take and calculate the longitude by lunar distances?' The young captain seemed somewhat nettled at my question, and answered me with a scornful smile—'*I* know how to calculate the longitude! Why, our *cook* can do *that!*' 'Your *cook!*' Here the owner of the ship and the old captain assured me that the cook on board could calculate the longitude very well, that he had a taste and passion for it, and did it every day. 'There he is,' said the young man, pointing with his finger to a negro at the stern of the ship, with a white apron before him, and holding a chicken in one hand and a butcher's knife in the other. 'Come forward, Jack,' said the captain to him; 'the gentleman is surprised that you can calculate the longitude; answer his questions.' I asked him, 'What method do you use to calculate the longitude by lunar distances?' His answer was, 'It's all one to me: I use the methods of Maskelyne, Lyons, Witchell, and Bowditch; but, upon the whole, I prefer Dunthorne's; I am more used to it, and can work with it quicker.' I could not express my surprise at hearing this black face talk in this way, with his bloody chicken and knife in his hand. 'Go,' said Mr. Crowninshield to him, 'lay down your chicken, bring your books and your journal, and show the gentleman your calculations.' The cook soon returned with his books under his arm. He had Bowditch's Practical Navigator, the Requisite Tables, Hutton's Tables of Logarithms, and the Nautical Almanac. I saw all this negro's calculations of the latitude, the longitude, and the true time, which he had worked out on the passage. He answered all my questions with wonderful accuracy, not in the Latin of the caboose, but in the good set terms of navigation."

Capt. Prince relates a little incident that occurred under his observation, that is worth preserving. In the year 1796, there was an Englishman in Boston, who called himself a professor of mathematics. He boasted a great deal about his mathematical knowledge, and said that he had not found any body in this country who knew any thing about the science. "I have a question," said he, "which I have proposed to several persons here who are reputed the most knowing, and they cannot solve it." This Englishman was a friend of E. H. Derby, Jr. of Salem, to whom Capt. Prince had some time previously said that he thought Mr. Bowditch "the greatest calculator in America." Mr. Derby and the Englishman being one evening at the theatre, and the latter repeating the remark about his question, "Well," says Mr. Derby, "there is a young man sitting opposite in that box, who, I think, will do it for you. You had better hand it over to him." Accordingly, after the play was over, the problem was brought to the house where Capt. Prince and Mr. Bowditch boarded, by a man named Hughes, who asked him whether he thought he could solve it. "Yes," was his instantaneous reply. The next morning Hughes called and asked him how he was getting along with the question. "I've done it," says Mr. Bowditch, "and I wish you would tell the Englishman that the answer is the logarithm of such a number," naming it. In addition to this, I have heard that the American mathematician said, "Tell your friend that I have got a question which puzzled me once a good while before I could make it out, and I should like to have him try his hand upon it." He gave him the question, and it was handed over to the Englishman; but nothing more was heard of it. For once, he had probably got enough of mathematics.

Capt. Prince states some facts in relation to the origin of one of Mr. Bowditch's principal works, which will be interesting to all, particularly to all seafaring men. Every thing relating to "The Sailor's Own Book," must be acceptable to them. He states, that on the day previous to their sailing on their fourth and last voyage together, Mr. Edmund M. Blunt, a noted publisher of charts and nautical books, then residing at Newburyport, came to Boston, where the ship lay, on purpose to see Mr. Bowditch. In the course of the conversation between them, which Capt. Prince overheard, Mr. Blunt said, "If you had not corrected the declination, I should have lost the whole of the last edition;" meaning the last edition of John Hamilton Moore's book on Navigation, then in common use on board our vessels. "Why," continued he, "can't you be good enough to look over Hamilton Moore again, more carefully? Take a copy of it with you, and mark whatever you may find; and when you get home, I will give you a new one." "Well," replied Mr. Bowditch, "I will." On the home passage Capt. Prince says that Mr. Bowditch remarked to him, "Now I am going to assist Blunt, and begin with Hamilton Moore." When he had been engaged upon it several days, Capt. Prince passed by him in the cabin, and said, "Well, sir, you seem to put a great many black marks on Johnny Moore." "Yes," replied Mr. Bowditch, "and well I may, for he deserves it; his book is nothing but a tissue of errors from beginning to end." After he had been hard at work for some time, Capt. Prince said to him, "If I were you, I would sooner make a new book than undertake to mend that old thing." Mr. Bowditch smiled and said, "I find so many errors that I intend to take out the work in my own name." Capt. Prince closed the conversation by adding, "I think you ought to do so, for the work will be new, and the fruit of your own labor, and will be the best work on navigation ever published;" a prediction that was wonderfully fulfilled to the letter.

As an illustration of the dangerous blunders of Moore's work, I will mention a fact related to me by John Waters, Esq. of Boston. He states that in the beginning of the year 1800, he was returning from Canton in the ship Eliza, and that somewhere this side of the Cape (he thinks off the West India Islands,) in taking the sun's declination one day, they turned to Moore's "Table XVII. of The Sun's Declination for the years 1792, 1796, 1800, 1804," to which he had appended the remark, "*each being leap year.*" In consequence of thus erroneously making 1800 a leap year, he gives the declination on the 1st of March 7° 11′, whereas by reference to the Nautical Almanac of that year, it will be found to be 7° 33′, making a difference of twenty-three miles. Mr. Waters fortunately had a Nautical Almanac on board, and likewise a copy of Pike's Arithmetic, which explained the reason *why* the year 1800 was *not* leap year. In consequence of this he escaped the dangers to which other vessels in the same latitude were subjected; for he afterwards read in the newspapers of several ships that were wrecked solely by reason of that blunder. It was, indeed, quite time for Hamilton Moore to be laid up, high and dry, on the shelf.

Before publishing his own work, Mr. Bowditch had prepared for Mr. Blunt two corrected editions of Moore's book, in which he had actually discovered and corrected *eight thousand* errors in the nautical tables, as he himself testifies in the preface to the last stereotype edition.

Such was the germ of "The New American Practical Navigator," the first edition of which he issued in the year 1800, at the age of twenty-seven; a work abounding with the actual results of his own experience, and containing simpler and more expeditious formulas for working the nautical problems. This work has been of immense service to the nautical and commercial interests of this country. Had Dr. Bowditch never done any thing else, he would still, by this single act, have conferred a lasting obligation upon his native land; and the national legislature might well acknowledge it by erecting a monument to his memory. Just consider the simple fact, that every vessel that sails from the ports of the United States, from Eastport to New Orleans, is navigated by the rules and tables of his book. And this has been the case nearly ever since its publication, thirty-eight years ago. Notwithstanding the competition of other English and American works on the subject, "The Practical Navigator" has never been superseded. It has kept pace with the progress of nautical science, and incorporated all its successive discoveries and results; and the last edition, published within the last year, contains new tables and other improvements, which will probably secure its undivided use by our seamen for years to come.

In compiling "The Navigator," he was essentially aided by a series of manuscript journals, preserved in the East India Museum, at Salem. It is one of the regulations of the East India Marine Society, to whom that splendid collection belongs, that each member shall keep a journal of every thing remarkable that has occurred, and that he has observed, during his voyage. On his return his journal is examined by a special committee, who extract whatever they think valuable, and copy it into large volumes, kept for that purpose. Dr. Bowditch was accustomed to say, that these volumes contained a mass of nautical information that could be found no where else in the world.

The quiet and leisure of the long East India voyages, when the ship was lazily sweeping along under the steady impulse of the trade-winds, afforded him fine opportunities for pursuing his mathematical studies, as well as for indulging his taste for general literature. It was at these times that he learnt the French and Spanish languages, without any instructor. Subsequently in life he acquired the German and the Italian.

I have heard it stated, that, on the voyage to Manilla, the ship sprung a leak, and was obliged to put into the Isle of France to refit. Young Bowditch was the only one on board who knew any thing about French, having learnt it from his grammar on the voyage; and this casual knowledge thus proved of essential service to the interests of the owners, as well as to the crew of the ship. He used to say, that nothing that he learnt ever came amiss.

He had previously commenced the study of Latin at the age of seventeen. The first Latin book that he undertook to read was a copy of Euclid's Geometry, which had formerly belonged to the Rev. Dr. Byles, of Boston, and having been purchased at the sale of his books, was presented to the young mathematician by his brother-in-law, David Martin, of Salem. The following words I copy from the blank leaf in the beginning of the book, "Began to study Latin Jan. 4, 1790." He afterwards read and translated Newton's "Principia," a copy of which book, rare, doubtless, at that time in this country, had come into his possession through the kindness of the learned and reverend Dr. Bentley of Salem. Dr. Bentley told him that he could not give him the book, as it had been presented to him by a friend, but said he would loan it to him, and that he might keep it till it was called for. He did keep it; it was never called for; and it is still among his books.

What he once learned he ever afterwards remembered, and it may be mentioned as an instance of the singular tenacity of his memory, that, on lately reading the splendid History of the Reign of Ferdinand and Isabella,* the last book he read through, and one for which he expressed the highest admiration, he remarked that many of the incidents in it were quite familiar to him, he having once read the great work of Mariana on the History of Spain, in the original language, in the course of one of his voyages. The French mathematician, Lacroix, acknowledged to a young American, that he was indebted to Mr. Bowditch for communicating many errors in his works, which he had discovered in these same long India voyages.

The extraordinary mathematical attainments of the young sailor soon became known, and secured to him the notice of our most distinguished men,—among others that of the late Chief Justice Parsons, himself an eminent mathematician,—and likewise the deserved, yet wholly unexpected, honors of the first literary institution in the land. In the summer of 1802, at the age of twenty-nine, his ship lying wind-bound in Boston harbor, he went out to Cambridge to attend the exercises of Commencement Day; and whilst standing in one of the aisles of the church, as the President was announcing the honorary degrees conferred that day, his attention was aroused by hearing his own name called out as a Master of Arts. The annunciation came upon him like a peal of thunder; it took him wholly by surprise. He has been heard to say that that was the proudest day of his life; and that of all the distinctions which he subsequently received from numerous learned and scientific bodies, at home and abroad,† (among which may be mentioned his election, in

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* By WILLIAM H. PRESCOTT, Esq. of Boston. This noble contribution to the youthful literature of our country is, at the same time, one of the most remarkable instances, in literary history, of the triumph of genius over difficulties and discouragements. It seems almost incredible, that so extensive a work, demanding the perusal of so many books, and the consultation of so many authorities, could have been composed without the full and free use of the eyes. And yet it is a fact known to me, that the author, although he wrote the book through with his own hand, never saw the words while he was writing them. His work is a noble evidence of his perseverance as well as of his learning and good taste, and reflects honor upon himself as well as upon his country.

† Dr. Bowditch was elected a Fellow of the American Academy of Arts and Sciences, in 1799, and was its President from 1829 to the time of his death. He was also a Fellow of the Royal Societies of Edinburgh and Dublin; of the Astronomical Society of London; of the American Philosophical Society held at Philadelphia; of the Connecticut Academy of Arts and Sciences; of the Literary and Philosophical Society of New York; Corresponding member of the Royal Societies at Berlin, Palermo, &c. &c. &c.

1818, as a Fellow of the Royal Society of London, an honor to which few Americans have attained,) there was not one which afforded him half the pleasure, or which he prized half so highly, as this degree from Harvard. It was, indeed, his first honor, his earliest distinction; it was not only kindly meant, but timely done; and it no doubt stimulated him to perseverance in his scientific pursuits, as well as created that interest which he always took in the prosperity of that institution.*

Mr. Bowditch's fifth and last voyage was made in the ship Putnam, of which he was part owner, and in which he sailed in the combined capacities of master and supercargo. He sailed for Sumatra in November, 1802, and returned in December, 1803. His habits of life and study, when on shipboard, are thus related by one who accompanied him in his two last voyages in the capacity of a seaman and mate.

"His practice was, to rise at a very early hour in the morning, and pursue his studies till breakfast; immediately after which, he took a rapid walk for an hour, and then went below to his studies till half past eleven o'clock, when he returned and walked till twelve o'clock, the hour at which he commenced his meridian observations. Then came dinner, after which he was engaged in his studies till five o'clock; then he walked till tea time, and, after tea, was at his studies till nine o'clock in the evening. From this hour till half past ten o'clock, he appeared to have banished all thoughts of study, and, while walking, he would converse in the most lively manner, giving us useful information, intermixed with amusing anecdotes and hearty laughs, making the time delightful to the officers who walked with him, and who had to quicken their pace to accompany him. Whenever the heavenly bodies were in distance to get the longitude, night or day, he was sure to make his observations once, and frequently twice, in every twenty-four hours, always preferring to make them by the moon and stars on account of his eyes. He was often seen on deck at other times, walking rapidly, and apparently in deep thought, when it was well understood, by all on board, that he was not to be disturbed, as we supposed he was solving some difficult problem, and when he darted below, the conclusion was, that he had got the idea; if he were in the fore part of the ship, when the idea came to him, he would actually run to the cabin, and his countenance would give the expression, that he had found a prize."

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* Mr. Bowditch was a Fellow of the Corporation of Harvard from 1826 till his death. He received the degree of LL. D. from the same University in 1816.

On quitting the sea, in 1803, he was appointed President of the Essex Fire and Marine Insurance Company in Salem, the duties of which he continued to discharge till the year 1823. During this time he was frequently solicited to accept posts of honor and emolument in various literary institutions, in different parts of the country. Though his salary as President of the Insurance Company was small, being only twelve hundred dollars, yet the larger offers from a distance could not induce him to leave his blessed New England home. Thus in 1806, he was chosen to fill the Hollis Professorship of Mathematics at Harvard University. In 1818, he received a letter from Mr. Jefferson, requesting him to accept the Professorship of Mathematics in the new University at Charlottesville, in Virginia. Mr. Jefferson said in his letter, "We are satisfied we can get from no country a Professor of higher qualifications than yourself for our mathematical department." And in 1820, on the death of Mr. Ellicott, Professor of Mathematics at the United States' Military Academy at West Point, he received a letter from Mr. Calhoun, then Secretary of War, desiring him to permit his name to be presented to the President to fill the vacant chair. Mr. Calhoun in that letter said, "I am anxious to avail myself of the first mathematical talents and acquirements to fill the vacancy."

In the year 1806, Mr. Bowditch published his accurate and beautiful chart of the harbors of Salem, Beverly, Marblehead, and Manchester, the survey of which had occupied him during the summers of the three preceding years. So minutely accurate was this chart, that the old pilots said he had found out all their professional secrets, and had put on paper points and bearings which they thought were known only to themselves. They began to fear that their services would no longer be needed, and that their occupation and their bread were gone.

On the establishment of "The Massachusetts Hospital Life Insurance Company," in 1823, he was elected to the office of Actuary, being considered the person best qualified for this highly responsible station, from his habits of accurate calculation and rigid method, and his inflexible integrity. Immediately on accepting the office he removed to Boston, at the age of fifty, and there spent the last fifteen years of his life. On his leaving Salem, a public dinner was given him by his fellow citizens, as a testimony of their respect. No man ever left that place more regretted.

It scarcely needs to be stated that he discharged the duties of his high trust with the greatest fidelity and skill, and to the entire satisfaction of the Company. The capital was five hundred thousand dollars. But, at his suggestion, the Company applied to the Legislature for additional power to hold in trust and loan out the property of individuals. This power was granted; and upwards of five millions of dollars, nine tenths of which belong to females and orphans, have been thus received and invested. The institution has, in this way, been of incalculable service, it being in fact nothing more nor less than a Savings Bank on a large scale. "Providence"—I use his own language, in his parting letter to the Directors—"has seen fit to bless our efforts to make it an institution deserving of public regard." It deserves to be mentioned, that Dr. Bowditch was never willing to receive and tie up any investment, without himself seeing or hearing in writing from the person in whose behalf the investment was to be made, and ascertaining that it was done with his or her full and free consent, and that the individual perfectly understood the mode and conditions of the investment, before it was put into the *dead hand* of the institution.

I may here also notice the fact, that during the late unexampled commercial embarrassments and financial difficulties, when almost all our moneyed institutions have sustained heavy losses from the bankruptcies of their debtors, "and," to use his own words in the same letter, "by having dealt with corporations, whose affairs have been managed with a recklessness which has never before been witnessed in this country," yet so carefully and skillfully have the affairs of The Life Office been managed, that, although the largest moneyed institution in New England, having a capital equal to ten common banks, and with a loan out of six millions, its loss has not been greater than that sustained by some of the smallest banks.

It was a hard struggle for Dr. Bowditch to break away from the pleasant scenes and associations of his native place. There were his earliest friends, and there his strongest ties. But he felt that he owed it to his family to make the sacrifice of personal attachments and preferences; and for some time he and his amiable consort fondly cherished the hope of returning and spending their last days in the City of Peace.

In March, 1798, just before sailing on his third voyage, he married his first wife, Elizabeth Boardman, who died during his absence at the age of eighteen. In October, 1800, he was married to his cousin, Mary Ingersoll, a lady of singular sweetness of disposition and cheerful piety, who, by her entire sympathy with him in all his studies and pursuits, lightened and cheered his labors, and by relieving him from all domestic cares, enabled him to go on, with undivided mind and undistracted attention, in the execution of the great work, on which his fame, as a man of science, rests. He has been heard to say, that he never should have accomplished the task, and published the book in its present extended form, had he not been stimulated and encouraged by her. When the serious question was under consideration as to the expediency of his publishing it at his own cost, at the estimated expense of ten thousand dollars, (which it actually exceeded,) with the noble spirit of her sex, she conjured and urged him to go on and do it, saying that she would find the means, and gladly make any sacrifice and submit to any self-denial that might be involved in it. In grateful acknowledgment of her sympathy and aid, he proposed, in the concluding volume, to dedicate the work to her memory—a design than which nothing could be more beautiful or touching. Let it still be fulfilled.*

It is hardly necessary for me to say that this was a Translation and Commentary on the great work of the French astronomer, La Place, entitled "*Mécanique Céleste*," in which that illustrious man undertakes to explain the whole mechanism of our solar system, to account on mathematical principles for all its phenomena, and to reduce all the anomalies in the apparent motions and figures of the planetary bodies, to certain definite laws.

La Place himself, in his Preface, states the object of his work as follows. "Towards the end of the seventeenth century, Newton published his discovery of universal gravitation. Mathematicians have since that epoch, succeeded in reducing to this great law of nature all the known phenomena of the system of the world, and have thus given to the theories of the heavenly bodies and to astronomical tables, an unexpected degree of precision. My object is to present a connected view of these theories, which are now scattered in a great number of works. The whole of the results of gravitation, upon the equilibrium and motions of the fluid and solid bodies, which compose the solar system, and the similar systems, existing in the immensity of space, constitute the object of *Celestial Mechanics*, or the application of the principles of mechanics to the motions and figures of the heavenly bodies. Astronomy, considered in the most general manner, is a great problem of mechanics, in which the elements of the motions are the arbitrary constant quantities. The solution of this problem depends, at the same time, upon the accuracy of the observations, and upon the perfection of the analysis. It is very important to reject every empirical process, and to complete the analysis, so that it shall not be necessary to derive from observations any but indispensable data. The intention of this work is to obtain, as much as may be in my power, this interesting result."

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* This noble-minded and excellent woman, whose unfailing cheerfulness and vivacity rendered her admirably suited to be the wife of such a man, died in Boston, on the 17th of April, 1834, in the 53d year of her age.

It is a work of great genius and immense depth, and exceedingly difficult to be comprehended. This arises not merely from the intrinsic difficulty of the subject, and the medium of proof employed being the higher branches of the mathematics,—but chiefly from the circumstance that the author, taking it for granted that the subject would be as plain and easy to others as to himself, very often omits the intermediate steps and connecting links in his demonstrations. He jumps over the interval, and grasps the conclusion as by intuition. Dr. Bowditch used to say, "I never come across one of La Place's '*Thus it plainly appears*,' without feeling sure that I have got hours of hard study before me to fill up the chasm, and find out and show *how* it plainly appears."

Dr. Bowditch says, in his Introduction to the first volume, "The object of the author, in composing this work, as stated by him in his Preface, was to reduce all the known phenomena of the system of the world to the law of gravity, by strict mathematical principles; and to complete the investigations of the motions of the planets, satellites, and comets, begun by Newton in his Principia. This he has accomplished, in a manner deserving the highest praise, for its symmetry and completeness; but from the abridged manner, in which the analytical calculations have been made, it has been found difficult to be understood by many persons, who have a strong and decided taste for mathematical studies, on account of the time and labor required to insert the intermediate steps of the demonstrations, necessary to enable them easily to follow the author in his reasoning. To remedy in some measure, this defect, has been the chief object of the translator in the Notes."

It was in the year 1815, at Salem, that he began this herculean task, and finished it in two years. The Commentary, which exceeds the original in extent, kept pace with the Translation; but whilst the publication was in hand, his alterations and additions were so numerous that it might almost be considered a new draft of the work.

Let it not be said, in disparagement of the labors of Dr. Bowditch, that this was not an original work, but merely a translation. Suppose that it had been so. What then? Was it not still a benefaction to this country and to Great Britain, thus to bring it within the reach and compass of the American and English mind?* It is truly said by an old writer, "So well is he worthy of perpetual fame that bringeth a good work to light, as is he that first did make it, and ought always to be reckoned the second father thereof." But the fact is, it is more than half an original commentary and exposition, simplifying and elucidating what was before complex and obscure, supplying omissions and deficiencies, fortifying the positions with new proofs and giving additional weight and efficiency to the old ones; and above all, recording and digesting the subsequent discoveries, and bringing down the science to the present time. I have heard it said that La Place, to whom Dr. Bowditch sent a list of errors, (which however he never had the grace to acknowledge in any way,)* once remarked, "I am sure that Mr. Bowditch comprehends my work, for he has not only detected my errors, but he has also shown me how I came to fall into them."

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* The only attempts that have been made in England to grapple with the great work of La Place are, 1. "An Elementary Treatise upon Analytical Mechanics, being the First Book of the Mécanique Céleste of La Place; translated and elucidated with Explanatory Notes, by the Rev. John Toplis, B. D., London. 1814." 8vo.—2. "Elementary Illustrations of the Celestial Mechanics of La Place, [by Thomas Young, M. D.] London. 1821." 8vo.—3. "A Treatise on Celestial Mechanics, by P. S. La Place; translated from the French, and elucidated with Explanatory Notes, by Rev. Henry H. Harte, Fellow of Trinity College, Dublin. Part First, Book First, 1822. Book Second, 1827. Dublin." 4to.

It is highly honorable to the sex, that the best, may I not say the only *Exposition* of La Place's work that has appeared in England, is from the pen of a female, the accomplished MARY SOMERVILLE, wife of Dr. Somerville, of Chelsea Hospital. The Edinburgh Review said of her work, entitled "The Mechanism of the Heavens," "This unquestionably is one of the most remarkable works that female intellect ever produced, in any age or country; and with respect to the present day, we hazard little in saying that Mrs. Somerville is the only individual of her sex in the world who could have written it."

The manner in which he published this work affords a striking illustration of the spirit of independence, which was a prominent feature in his character. He had been frequently solicited and urged by his numerous wealthy friends, and by eminent scientific men, and formally requested by the American Academy of Arts and Sciences, to permit them to print it at their expense, for the honor of the country, and for the cause of science. He was well aware, however, that there was not sufficient taste in the community for such studies to justify an enterprise which would involve a great outlay, and, as he thought, would bring him under pecuniary obligations to others. I recollect conversing with him once on this subject, when he said to me, in his usual ardent way, "Sir, I did not choose to give an opportunity to such a man (mentioning his name) to point up to his book-case and say, 'I patronized Mr. Bowditch by subscribing for his expensive work,' —not a word of which he could understand. No. I preferred to wait till I could afford to publish it at my own expense. That time at last arrived; and if, instead of setting up my coach, as I might have done, I see fit to spend my money in this way, who has any right to complain? My children I know will not."

On the publication of the first volume, the London Quarterly Review, expressed the following high opinion of its merits. "The idea of undertaking a translation of the whole 'Mécanique Céleste,' accompanied throughout with a copious running commentary, is one which savors, at first sight, of the *gigantesque,* and is certainly one which, from what we have hitherto had reason to conceive of the popularity and diffusion of mathematical knowledge on the opposite shores of the Atlantic, we should never have expected to have found originated—or, at least, carried into execution, in that quarter. The first volume only has as yet reached us; and when we consider the great difficulty of printing works of this nature, to say nothing of the heavy and probably unremunerated expense, we are not surprised at the delay of the second. Meanwhile the part actually completed (which contains the first two books of La Place's work) is, with few and slight exceptions, just what we could have wished to see—an exact and careful translation into very good English—exceedingly well printed, and accompanied with notes appended to each page, which leave no step in the text of moment unsupplied, and hardly any material difficulty either of conception or reasoning unelucidated. To the student of 'Celestial Mechanism,' such a work must be invaluable, and we sincerely hope that the success of this volume, which seems thrown out to try the feeling of the public, both American and British, will be such as to induce the speedy appearance of the sequel. Should this unfortunately not be the case, we shall deeply lament that the liberal offer of the American Academy of Arts and Sciences, to print the whole at their expense, was not accepted. Be that as it may, it is impossible to regard the appearance of such a work, even in its present incomplete state, as otherwise than highly creditable to American science, and as the harbinger of future achievements in the loftiest fields of intellectual prowess."

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* This, possibly, may have been an inadvertence, or the letter of acknowledgment may have miscarried on the way. It is certain that his widow received the son of the American mathematician with great kindness and consideration, when in the year 1833, he went to Paris to pursue his medical studies, carrying out with him the second volume of his father's work. He was immediately invited to a splendid *soirée*, and on entering the brilliant saloon, filled with the *savans* of France, he was unexpectedly greeted by seeing on the centre table,—the only thing on it,—the identical volume which he had brought over with him—a delicate compliment, which none but a graceful French woman would have thought of paying. Madame La Place subsequently sent to Dr. Bowditch a noble colossal bust of her husband.

The first volume of the work was published in the year 1829, the second in 1832, and the third in 1834, each volume containing about a thousand quarto pages. The fourth volume was nearly completed at the time of his decease. He persevered to the last in his labors upon it, preparing the copy and reading the proof-sheets in the intervals when he was free from pain. The last time I saw him, a few days previous to his death, a proof-sheet was lying on his table, which he said he hoped to be able to read over and correct.

The publication of the book proved, as he anticipated, and as I have already mentioned, a very expensive undertaking, it being one of the largest works and most difficult of execution ever printed in this country, and at the same time one of the most beautiful specimens of typography.

Though it met with more purchasers than the author ever expected, still the cost was a heavy draught upon his income, and an encroachment on his little property. Yet it was cheerfully paid; and besides that, he gladly devoted his time, his talents, and may I not add, his health and his life, to the cause of science and the honor of his native land. That work is his monument. *Si monumentum quæris, aspice librum.** He needs no other monument; and at the same time it is the most precious and honorable legacy that he could bequeath to his children.

Among the numerous services which Dr. Bowditch rendered to the cause of good learning and the diffusion of useful knowledge, after he came to Boston, was the deep and active interest which he took in the Boston Athenæum. When, in 1826, the Perkins family, in that liberal spirit which has ever characterized them, gave to the Athenæum sixteen thousand dollars, on condition that an equal sum should be raised from other sources, Dr. Bowditch exerted himself to the utmost to accomplish the object. Many of the best friends of the institution thought the enterprise a hopeless one, and were indisposed even to make an attempt to raise the amount. But Dr. Bowditch said, "It is a good thing, let us try it; if we fail, we fail in a good cause." He called personally on many individuals to solicit subscriptions, and chiefly in consequence of his exertions, the additional sum of twenty-seven thousand dollars was raised.

The permitting the books to be taken out of the library was another measure proposed and effected by him. Strenuous opposition was made to it; but he believed and said that the circulation of the books would make the library ten times more useful, and he persevered till he accomplished the measure. It was always a favorite object with Dr. Bowditch to render books easily accessible to those who wanted them, and could make a good use of them. He doubtless remembered the difficulties under which he labored in early life for want of books, and was disposed to obtain for others the advantages which had been extended to himself.

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* I have ventured to alter a little and apply to Dr. Bowditch, the well-known epitaph on Sir Christopher Wren, beneath the dome of St. Paul's Cathedral, London :—"SI MONUMENTUM QUÆRIS, CIRCUMSPICE."

Immediately after his election as Trustee of the Athenæum, in 1826, Dr. Bowditch, perceiving the paucity and poverty of the scientific department of the library, which might all be put into one small compartment,—"*dum tota domus rhedâ componitur unâ*,"—declared that "it was too bad, and a disgrace to the institution and to Boston." He accordingly set about supplying the deficiency, by collecting subscriptions for this express purpose. Col. T. H. Perkins gave $500, his brother James the same amount, Dr. Bowditch himself $250, and other gentlemen $100 apiece. With this sum were purchased the Transactions of the Royal Societies of London, Dublin, and Edinburgh, of the French Academies and Institute, of the Academies of Berlin, Göttingen, St. Petersburg, Turin, Lisbon, Madrid, Stockholm, and Copenhagen; forming, as Dr. Bowditch once told the librarian, "the most extensive and complete collection of philosophical and scientific works on this continent."

Dr. Bowditch also took a deep interest in the "Boston Mechanics' Institution," which was established in 1826, and of which he was elected the first President, January 12, 1827. In 1828, more than a thousand dollars was subscribed for the purchase of philosophical apparatus, chiefly through his influence with his friends, and he headed the list with the sum of one hundred dollars. On resigning the Presidency, in 1829, he was elected first honorary member of the institution.

Dr. Bowditch was likewise an honorary member of the Massachusetts Charitable Mechanic Association. On the 3d of April a Eulogy on their departed associate was pronounced before that body by the author of this Memoir; on which day the flags of all the shipping in the port were hauled to half-mast by direction of the Boston Marine Society, of which he was likewise a member. His sense of the honor thus conferred on him by these elections, and his affectionate regard for these Societies, and for the city of his adoption, will be best seen by the following extract from his Will:—

"And, in respect to Boston, the home of my adoption, where, as a stranger, I met with welcome, and where I have ever continued to receive constantly increasing proofs of kindness and regard, I should have been most happy to have made a similar acknowledgment of my gratitude, by legacies to those literary and charitable institutions for which that city has always been so preëminently distinguished. And, in particular, it would have given me pleasure to have noticed the Boston Marine Society, of which I am a member, and the Boston Charitable Mechanic Association, which has placed my name on its small and select list of honorary members; since these institutions are of a similar character to the Marine Societies in Salem, and have, for one of their important objects, that of affording valuable aid to the destitute families of deceased members. But the pecuniary circumstances of my estate do not permit it."

In delineating the character of Dr. Bowditch, it deserves to be mentioned, first of all, that he was eminently a self-taught and self-made man. He was the instructor of his own mind, and the builder up of his own fame and fortunes. Whatever knowledge he possessed,—and we have seen that it was very great,—was of his own acquiring, the fruit of his solitary studies, with but little, if any, assistance from abroad. Whatever eminence he reached, in science or in life, was the product of his untiring application and unremitting toil. From his youth up, he was a pattern of industry, enterprise, and perseverance, suffering no difficulties to discourage, no disappointments to dishearten him.

Within a few years, a very interesting work has been published in England, under the patronage of the Society for the Diffusion of Useful Knowledge, entitled "The Pursuit of Knowledge under Difficulties." Dr. Bowditch deserves a place in that work, if any man does, and had he died before its appearance, he would, unquestionably, like our countryman Franklin, have occupied a prominent chapter. We sometimes hear persons say, how much they would do, if they only had the means and the opportunities. But almost any body can work with means and opportunities. It is the privilege and characteristic of genius to work without means, to be great in spite of them, to accomplish its object in the face of obstacles and difficulties.

It would be interesting and instructive, had we space for it, to draw a parallel and contrast between the lives, characters and scientific attainments of Franklin and Bowditch, unquestionably the two greatest proficients in science that America has produced.

Both rose from obscure situations in humble life, and from the straits of poverty. Both left school at the age of ten years, to assist their fathers in their shops. Both had an early and passionate love of reading, and the vigils of both often "prevented the morning." Both had the same habits of industry, perseverance and temperance. The contrast between their characters would be still more striking than the resemblance.

It was my good fortune, some years since, in one of those familiar interviews with him in his own house with which I was favored,—and which those who have once enjoyed them will never forget,—to hear him narrate, in detail, a history of his early life. From that day to this, I have never ceased to regret that, on my return home, I did not instantly put it down upon paper, for the refreshment of my own memory, and for the benefit of others. At this distance of time, I can recollect but a few, the most striking, particulars; the rest have faded away and are lost. I remember, however, very distinctly, his relating the circumstance which led him to take an interest in the higher branches of mathematical science. He told me that, in the year 1787, when he was fourteen years old, an elder brother of his, who followed the sea, and was attending an evening school, for the purpose of learning navigation, on returning home one evening, informed him that the master had got a new way of doing sums and working questions; for, instead of the numerical figures commonly used in arithmetic, he employed the letters of the alphabet. This novelty excited his curiosity, and he questioned his brother very closely about the matter; who, however, did not seem to understand much about the process, and could not tell how the thing was done. But the master, he said, had a book, which told all about it. This served to inflame his curiosity; and he asked his brother whether he could not borrow the book of the master, and bring it home, so that he might get a sight at it. (It should be remembered that, at this time, mathematical books of all sorts were scarce in this country. In the present multitude of elementary works on this subject, we can hardly conceive of the dearth that then prevailed.) The book was obtained. It was the first glance that he had ever had at algebra. "And that night," said he, "I did not close my eyes." He read it, and read it again, and mastered its contents, and copied it out from beginning to end. Subsequently, he got hold of a volume of the Philosophical Transactions of the Royal Society of London, which he treated pretty much in the same summary way, making a very full and minute abstract of all the mathematical papers contained in it; and this course he pursued with the whole of that voluminous work. He was too poor at this time to purchase books, and this was the only mode of getting at their results, and having them constantly at hand for consultation. These manuscripts, written in his small, close, neat hand, and filling several folio volumes, are now in his library, and, in my opinion, are the most curious and precious part of that large and valuable collection.

I have more than once heard him speak in the most grateful manner,—and he repeated it the last time that I saw him,—of the kindness of those friends in Salem who aided him in his early studies by the loan of their books. He named particularly the late eminent Dr. Prince,* the pastor of the First Church, who gave him free access to his library; and he likewise mentioned a society of gentlemen who had a private collection of their own. The manner in which these latter books came into the country, is so remarkable, that I am happy to be able to relate it in Dr. Bowditch's own words, as contained in his last Will. The extract is as follows:—

"*Item.* It is well known, that the valuable scientific library of the celebrated Dr. Richard Kirwan† was, during the revolutionary war, captured in the British Channel, on its way to Ireland, by a Beverly privateer; and that, by the liberal and enlightened views of the owners of the vessel, the library thus captured was sold at a very low rate; and in this manner was laid the foundation upon which have since been successively established, The Philosophical Library, so called, and the present Salem Athenæum. Thus, in early life, I found near me a better collection of philosophical and scientific works than could be found in any other part of the United States nearer than Philadelphia. And by the kindness of its proprietors I was permitted freely to take books from that library and to consult and study them at pleasure. This inestimable advantage has made me deeply a debtor to the Salem Athenæum; and I do therefore give to that Institution the sum of one thousand dollars, the income thereof to be for ever applied to the promotion of its objects and the extension of its usefulness."

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* It is gratifying to find the clergy, the scientific Dr. Prince, and the learned Dr. Bentley, the earliest encouragers of the precocious powers of the American mathematician. It has always been so. The Christian clergy have, from the beginning down to this day, not only been themselves among the most learned men of their times, but have always been the fosterers of early talent, and the patrons of unfriended genius.

† The Rev. Richard Kirwan was a native of Ireland, and was distinguished for his attainments in mineralogy and chemistry. His principal work was his Elements of Mineralogy, published in 1784. He died in 1812.

I have two remarks to make on this singularly interesting extract. In the first place, it seems to me there was something like a special providence in the capture of that library, consisting of such a peculiar class of books, by a Beverly vessel, and its being brought into the port of Salem rather than any other port in the United States. Here was apparent design, the fitting of means to ends. The books came exactly to the place where they were wanted; to the only place, probably, in the country where they were wanted. They came, too, at the right time, just in season to be used by the person who could make the best possible use of them, and to whom they were, above all computation, valuable and necessary. If this be not an act of Providence, I hardly know what is.

The good Dr. Kirwan mourned, no doubt, over the loss of his books, and not least of all that they had become so utterly misplaced and useless. He probably thought that the vessel which contained them might as well have been wrecked on the coast of Africa, and the leaves of his philosophical works employed to adorn the heads and persons of the Caffres and Hottentots, a use to which we are told "The Practical Navigator" was once put by the inhabitants of one of the South Sea islands.* But had the learned philosopher known that his lost library had supplied the intellectual food for the growth of one of the greatest scientific men of his age, he might, perhaps, have become reconciled to his loss.†

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* "It happened that among the few articles saved from the ship, [the whale-ship Mentor, of New Bedford,] was a copy of 'Bowditch's Navigator;' an article of as little use as we can conceive any one thing to have been at that place. But the ingenuity of the females, who also have their passion for ornaments, tore out the leaves of the book, and making them into little rolls of the size of one's finger, wore them in their ears, instead of the tufts of grass which they usually employed to give additional attractions to their native charms."—*American Quarterly Review of Holden's Narrative, Vol. XX, p. 25.*

† Since the above was written, I have learnt that the gentleman into whose hands Dr. Kirwan's library fell, offered to remunerate him for the loss which he had sustained. He however declined receiving any compensation, and expressed himself gratified that his books had fallen into such good hands.

My other remark is, that this item in his Will is an indication of a very prominent feature in his character, namely, his grateful and generous spirit. Dr. Bowditch never forgot a favor; length of time did not obliterate it from his memory. The kindness shown him when a poor boy he remembers and repays by a liberal legacy. The Salem Marine Society, a mutual charitable institution, which had aided his father in his straits by the small annual stipend of fifteen dollars, he repays, and wipes off the obligation, though not his sense of the benefit, by a similar bequest of a thousand dollars. And the East India Marine Society, whose peculiar and splendid collection of curiosities is so well known, receives a legacy of the same amount. And let it be remembered that these were not the donations of a rich man. He was far from being one. These three legacies constituted one tenth part of his whole personal property. Others sometimes give to such institutions from their abundance—he from his comparative penury. Let the deed be an example and an incitement to our wealthy men!

Dr. Bowditch combined, in a very remarkable degree, qualities and habits of mind which are usually considered incompatible and hostile. He was a contemplative, recluse student, and at the same time, an active, public man. He lived habitually among the stars, and yet, I doubt not, he seemed to many never to raise his eyes from the earth. He was a profound philosopher, and at the same time, a shrewd, practical man, and one of the most skilful of financiers. Judging from his published works, you would suppose that he could have no taste nor time for business or the world; and judging from the large concerns which he managed, and the vast funds of which he had the supervision,—involving the most complex calculations and the most minute details,—you would say that he could have no taste nor time for study. His example is a conclusive proof and striking illustration of the fact, that there is no inherent, essential, necessary incompatibility between speculation and practice—that there need be no divorce between philosophy and business. The man most deeply engaged in affairs need not be cut off from the higher pursuits of intellectual culture; and the scholar need not be incapacitated by his studies from understanding and engaging in the practical details of common life. In fact, they should be blended in order to make up the full, complete man. Contemplation should be always united with action. This was the doctrine and the practice of the great father of inductive philosophy, as well as of this his illustrious pupil. "That," says Lord Bacon, "will indeed dignify and exalt knowledge, if contemplation and action may be more nearly and strongly conjoined and united together than they have been, —a conjunction like unto that of the two highest planets, Saturn, the planet of rest and contemplation, and Jupiter, the planet of civil society and action." And speaking of himself in another place, he says, "We judge also that mankind may conceive some hopes from our example; which we offer not by way of ostentation, but because it may be useful. If any one therefore should despair, let him consider a man as much employed in civil affairs as any other of his age,—a man of no great share of health, who must therefore have lost much time,—and yet, in this undertaking, he is the first who leads the way, unassisted by any mortal, and steadfastly entering the true path, that was absolutely untrod before, and submitting his mind to things, may somewhat have advanced the design."

In the management of all his affairs and transactions, Dr. Bowditch was a man of great order and system, and he required it of all with whom he had to do, or over whom he exercised any control. He considered that there was a sort of moral virtue in this, and he could not tolerate any thing like negligence or irregularity. He doubtless had himself acquired this habit from the nature of his favorite study, which demands the undivided attention of the mind, and is peculiarly suited to form habits of exactness and precision. He felt, too, that it was by a strict and undeviating adherence to order and system, that he had been enabled to accomplish so much in life, to unite the scholar with the financier, the speculative with the practical man. It may have been thought by some, that he carried this love of order to an extreme, and sometimes visited too harshly the deviations from the straight line of his directions. But he felt assured that it was the way to effect the most work and do the greatest good; he knew that the habit could be easily formed in a short time, and that it would then approve and recommend itself; and therefore he would admit of no apology for infractions of his rules.

In the common sense of the word, Dr. Bowditch would not be called a public man, although I have ventured to call him so; for though he twice held a seat in the Executive Council of

Massachusetts, under the administrations of Governors Strong and Brooks, yet he had no taste for public life, no ambition for political honors. He could not be drawn from "the still air of delightful studies," to mingle in the turmoil and strife of politics. And yet he was a true-hearted and sound patriot, and not a whit the less so for not being a noisy one. He loved his country, and prized her peculiar institutions. He felt a deep interest in the welfare and honor of his native State, and would do any thing to maintain the supremacy of the laws, and preserve the peace and order of the community. He had a remarkably sound and sober mind, good sense being one of its most prominent qualities. Accordingly, he could have no sympathy with those visionary reformers who would jumble society into its original elements, and bring back ancient chaos again, in order to get a chance to try their hand at making the very best possible commonwealth out of the fragments. No. He valued the lessons of experience, and prized the gathered wisdom of ages. He had faith in other men's intelligence, as well as his own, and trusted in the light that had been reflected from a thousand brilliant minds who had pored and pondered over the great questions of government and civil polity, and given us their results in laws and institutions.

Dr. Bowditch thought, with Governor Winthrop, in his noble apology for himself, that "there is a great mistake in the country about liberty. There is a two-fold liberty; natural, and civil or federal. The first is common to man with beasts and other creatures. By this, man, as he stands in relation to man simply, hath liberty to do what he lists; it is a liberty to evil as well as to good. This liberty is incompatible and inconsistent with authority, and cannot endure the least restraint of the most just authority. The exercise and maintaining of this liberty makes men grow more evil, and, in time, to be worse than brute beasts: 'omnes sumus licentiâ deteriores.' This is that great enemy of truth and peace, that wild beast, which all the ordinances of God are bent against, to restrain and subdue it. The other kind I call civil, or federal; it may also be termed moral, in reference to the covenant between God and man, in the moral law, and the politic covenants and constitutions, amongst men themselves. This liberty is the proper end and object of authority, and cannot subsist without it; and it is a liberty to that which is good, just, and honest. This liberty you are to stand for, with the haz-

and not only of your goods, but of your lives, if need be. Whatsoever crosses this, is not authority, but a distemper thereof. This liberty is maintained and exercised in a way of subjection to authority."*

The lawless and flagrant assaults upon property and life which have occurred in this country within a few years past, casting upon its fair name a stain of dishonor, grieved him to the heart, and stirred his spirit within him. Conversing with him about one of the earliest and most wanton and unprovoked of these outrages,—I mean the conflagration of a religious house in the vicinity of Boston, inhabited solely by women and children, by a ferocious mob at midnight,—he told me that had he been summoned, or had an opportunity, he would readily have shouldered his musket, and marched to the spot, and stood in defence of that edifice to the last drop of his blood. There was nothing, indeed, that stirred his indignation like oppression.†

Immediately after this outrage, he called on the Catholic bishop in Boston, and put into his hands a sum of money, to buy clothes for the women and children, who had lost every thing in the flames. It is an agreeable circumstance, well worth recording, that as soon as the bishop heard of Dr. Bowditch's illness, he sent and informed the family, that, to prevent his being disturbed, the bell of the cathedral, which is in the vicinity of his house, should not be rung during his illness, although it was the season of Lent, and religious services were going on almost every day. It is pleasant to see kindness thus reciprocated between divergent sects, and the middle wall of separation broken down by the humane and grateful feelings of a common nature.

Why is it, that all the youthful talent of this country is rushing madly into political life? To how many of these aspirants may we apply, with literal truth, the remark of Lord Bacon, in reference to himself, that "they were born and intended for literature, rather than any thing else, and, by a sort of fatality, have been drawn, contrary to the bent of their own genius, into the walks of public life."‡ Is it not a great mistake, on their part, to suppose that politics is the only or the principal avenue to enduring fame? Is the science of government the only one worth studying, or are civil honors the only ones worth aspiring to? It seems to me that the young men of competent abilities among us, who aim at distinction, those certainly who have leisure and property, might quite as securely seek it in the retired and quiet walks of science and literature, as in the bustling and dusty paths of political life. Are the names of Newton and Milton less eminent than those of Chatham and Fox? Do they not stir the spirit as soon? ay, even as soon as those of Marlborough and Wellington? Are Cuvier and La Place names less likely to live than those of the statesmen and marshals of France? Which are the two greatest names in our own annals, the best known and the most honored the world over? First, Washington; then Franklin; and the latter chiefly as a philosopher, from his attainments and discoveries in science.

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* Winthrop's History of New England, II. 229.

† "The Ursuline Convent," on Mount Benedict, in Charlestown, about two miles from Boston, was burnt on the night of the 11th of August, 1834.

‡ Ad literas potius quam ad aliud quicquam natus, et ad res gerendas, nescio quo fato, contra genium suum abreptus.—*De Aug. Sci. Lib.* 8. *Cap.* 3.

The example and success of Dr. Bowditch are full of incitement and encouragement to our young men in this particular, and should especially stimulate those who have leisure and fortune, to do something to enable our country to take a respectable place in science and letters among the other nations of the earth; so that the stigma shall not adhere to us of being a race of unlettered republicans. Let them look, too, at more than one recent and successful attempt among us in the department of history.* How much may they not accomplish? And into what pleasant fields will they not be led? Into the various departments of natural history, the different walks of exact science, the rich and instructive annals of our own country, and the delightful province of general literature and philosophy. Let them labor in this field, which will reward all their efforts, instead of delving in a stony and sterile soil.

I have no fear that the path of politics will be deserted, or that the republic will suffer detriment from the absence of candidates for its offices and emoluments. Alas! these will always be too attractive; and what we chiefly need is some counteracting influence, some striking example, like that of Dr. Bowditch, to convince our young men that political life is not the only road to eminence, nor the only adequate and honorable sphere for the exercise and display of their talents. For affording us this evidence, his memory deserves to be honored, and his name to be held in everlasting remembrance.

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* Mr. Prescott's "History of the Reign of Ferdinand and Isabella, the Catholic," already alluded to, and Mr. George Bancroft's "History of the United States." These are very important and honorable contributions to the growing literature of our country; and we rejoice that we can claim them as the works of New-England men.

Dr. Bowditch was a remarkably domestic man. His affections clustered around his own fireside, and found their most delightful exercise in his "family of love," as he called it in almost his last moments. His attachment to home, and to its calm and simple pleasures was, indeed, one of the most beautiful traits in his character, and one which his children and friends will look back upon with the greatest satisfaction. As Sir Thomas More says of himself, "he devoted the little time which he could spare from his avocations abroad, to his family, and spent it in little innocent and endearing conversations with his wife and children; which, though some might think them trifling amusements, he placed among the necessary duties and business of life; it being incumbent on every one to make himself as agreeable as possible to those whom nature has made, or he himself has singled out for, his companions in life."[*]

His time was divided between his office and his house; and that must have been a strong attraction, indeed, that could draw him into company. When at home, his time was spent in his library, which he loved to have considered as the family parlor. By very early rising, in winter two hours before the light, "long ere the sound of any bell awoke men to labor or to devotion," and "in summer," like Milton, "as oft with the bird that first rises or not much tardier," he was enabled to accomplish much before others were stirring. "To these morning studies," he used to say, "I am indebted for all my mathematics."[†] After taking his evening walk he was again always to be found in the library, pursuing the same attractive studies, but ready and glad, at the entrance of any visitor, to throw aside his book, unbend his mind, and indulge in all the gayeties of his light-hearted conversation.

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[*] "Dum foris totum ferme diem aliis impertior, reliquum meis, relinquo mihi, hoc est literis, nihil. Nempe, reverso domum, cum uxore fabulandum est, garriendum cum liberis, colloquendum cum ministris. Quæ ego omnia inter negotia numero, quando fieri necesse est, (necesse est autem nisi velis esse domi tuæ peregrinus,) et danda omnino opera est, ut quos vitæ tuæ comites aut natura providit, aut fecit casus, aut ipse delegisti, his ut te quam jucundissimum compares."—*Preface to Utopia*.

[†] He might literally apply to himself the apology of the great Roman orator, "Quare quis tandem me reprehendat, aut quis mihi jure succenseat, si quantum cæteris ad suas res obeundas, quantum ad festos dies ludorum celebrandos, quantum ad alias voluptates, et *ad ipsam requiem animi et corporis* conceditur temporis; quantum alii tribuunt tempestivis conviviis; quantum denique aleæ, quantum pilæ; tantum mihi egomet ad hæc studia recolenda sumpsero?"

There was nothing that he seemed to enjoy more than this free interchange of thought on all subjects of common interest. At such times the mathematician, the astronomer, the man of science, disappeared, and he presented himself as the frank, easy, familiar friend. One could hardly believe that this agreeable, fascinating companion, who talked so affably and pleasantly on all the topics of the day, and joined so heartily in the quiet mirth and the loud laugh, could really be the great mathematician who had expounded the mechanism of the heavens, and taken his place with Newton, and Leibnitz, and La Place, among the great proficients in exact science. To hear him talk, you would never have suspected that he knew any thing about science, or cared any thing about it. In this respect he resembled his great Scottish contemporary, who has delighted the whole world by his writings. You might have visited him in that library from one year's end to another, and yet, if you or some other visitor did not introduce the subject, I venture to say, that not one word on mathematics would cross his lips. He had no pedantry of any kind. Never did I meet with a scientific or literary man so entirely devoid of all cant and pretension. In conversation he had the simplicity and playfulness and unaffected manners of a child. His own remarks "seemed rather to escape from his mind than to be produced by it." He laughed heartily, and rubbed his hands, and jumped up, when an observation was made that greatly pleased him, because it was natural for him so to do, and he had never been schooled into the conventional proprieties of artificial life, nor been accustomed to conceal or stifle any of the innocent impulses of his nature.

Who that once enjoyed the privilege of visiting him in that library, can ever forget the scene? Methinks I see him now, in my mind's eye, the venerable man, sitting there close by his old-fashioned blazing wood fire, bending over his favorite little desk, looking like one of the old philosophers, with his silvery hair, and noble forehead, and beaming eye, and benign countenance; whilst all around him are ranged the depositories of the wisdom and science of departed sages and philosophers, who seem to look down upon him benignantly from their quiet places, and spontaneously and silently to give forth to him their instructions. On entering this, the noblest repository of scientific works in the country, I almost fancy I hear him saying with Heinsius, the keeper of the library at Leyden, "I no sooner come into my library, than I bolt the door after me, excluding ambition, avarice, and all such vices; and, in the very lap of eternity, amidst so many divine souls, I take my seat with so lofty a spirit and such sweet content, that I pity all the great and rich who know not this happiness."

It may be here remarked, that although mathematics was his chief and favorite pursuit, Dr. Bowditch still had a taste and love for general literature. He was fond of Shakspeare and Milton, and remembered and could repeat whole passages from their works. He loved, too, the poetry of Burns and our own Bryant and Sprague. Many of his favorite pieces he not only had by heart, but also had them written down, for convenience' sake, on the covers of his mathematical common-place book. I recollect, among others, thus copied off, "The Cotter's Saturday Night," a selection which evinced at the same time his good feeling and his good taste. I also recollect observing on the covers and blank leaves of his copy of Newton's Principia many commendatory verses on Newton, selected from Voltaire and other French poets.

But I must hasten on to speak, as briefly and comprehensively as I can, of what is the most important part of every man—namely, his moral and religious character—the qualities of his heart, and his principles of action.

Dr. Bowditch was a man of unsullied purity, of rigid integrity, and uncompromising principle. Through life, truth seems to have been at once the great object of his pursuit, and his ruling principle of action. "FOLLOW TRUTH," might have been the motto on his escutcheon. "*Truth! Truth! Truth!*" were among his last words to one whom he dearly loved. He was himself perfectly transparent. A child could see through him. There was no opaqueness in his heart, any more than in his intellect. It was as clear as crystal, and the rays of moral truth were transmitted through it without being refracted or tinged. In all his intercourse and transactions he was remarkably frank and candid. He revealed himself entirely. He had no secrets. He kept nothing back, for he had nothing to conceal. He lived openly, and talked freely, of himself, and of his doings, and of every thing that was uppermost in his mind. He never hesitated to speak out what he thought on all subjects, public and private, and he avowed his opinions of men and things with the utmost freedom and unconcern. It seemed to me that he never had the fear of man before his eyes, and that it never checked, in the least, the free and full utterance of his sentiments.

Dr. Bowditch was perfectly fair and just in the estimate which he formed of his own capacities and gifts. He did not, on the one hand, overrate his talents; nor, on the other hand, did he, as some do, with a sort of back-handed humility, purposely undervalue his powers, in order to enjoy the pleasure of being contradicted by those about him and told that he was really a much greater man than he seemed willing to admit. As an illustration of this, let me mention a little conversation of his. "People," said he, "are very kind and polite, in mentioning me in the same breath with La Place, and blending my name with his. But they mistake both me and him; we are very different men. I trust I understand his works, and can supply his deficiencies, and correct his errors, and render his book more intelligible, and record the successive advancements of the science, and perhaps append some improvements. But La Place was a genius, a discoverer, an inventor. And yet I hope I know as much about mathematics as Playfair!"

I have been informed by a gentleman of Boston, that soon after his return from Europe a few years since, he happened, in a conversation with Dr. Bowditch, to mention to him incidentally, the high estimation in which he and his labors were held by men of science abroad, and told him that he had often heard his name spoken of in terms of the strongest commendation by persons in the most elevated walks of society in England. "Dr. Bowditch," says my informant, "seemed to be sensibly affected by my statement, so much so that I saw the tears glisten in his eyes. But he immediately remarked that however flattering such testimonials might be, yet the most grateful tribute of commendation he had ever received was contained in a letter from a backwoodsman of the West, who wrote to him to point out an error in his Translation of the *Mécanique Céleste*. 'It was an actual error,' said the Doctor, 'which had escaped my own observation. The simple fact that my work had reached the hands of one on the outer verge of civilization, who could understand and estimate it, was more gratifying to my feelings than the eulogies of men of science and the commendatory votes of Academies.'"

He was a singularly modest man. He made no pretensions himself and there was nothing that he so much despised in others. He was remarkably simple in all his manners and intercourse with the world. He put on no airs and assumed no superiority on the ground of his intellectual attainments, but placed himself on a level with every one with whom he had any concern. He reverenced integrity and truth wherever he found them, in whatever condition in life. He felt and showed no respect for mere wealth or rank. He fearlessly rebuked, to his face, the mean and purse-proud nabob, and "condescended to men of low estate."

Dr. Bowditch used to relate a little anecdote concerning himself, which strongly and beautifully illustrates the childlike simplicity and naturalness of his character.

In the year 1824, when General Lafayette, in his progress through the country, among other places, visited Boston, the mayoralty of the city was filled by the Honorable Josiah Quincy. Dr. Bowditch, in common with all the world, had a curiosity to behold the entrance of the nation's guest into the city; and accordingly accepted an invitation from a friend, whose house was in Colonnade Row, to take a station on his balcony. But finding that the chariot wheels tarried, and the General delayed his coming, he thought that he should have time to go down to his office to transact a little business, and return in season for the spectacle. But, in the mean time, the procession had arrived and passed on, and was fast advancing to State street. He concluded, therefore, to wait where he was, and, in order to get a nearer and better view, took his stand on the steps of the United States' Bank. On the appearance of the barouche in which Lafayette was seated, Dr. Bowditch remarked, that he was glad to see Mr. Quincy at his side; he was the proper man for that place, being the son of one of the earliest and best of the patriots of the Revolution. "As the shout of the multitude rose unto heaven," he said, "I know not how it happened, but I could not keep my place; my hat would not stay on my head, nor could I hold my tongue. And to my astonishment, I found myself, all at once, in the midst of the crowd by the side of the chariot, and shouting with the rest at the top of my voice." The President of Harvard University recollects distinctly seeing him in the position and attitude thus described.

At first sight there may seem something ludicrous and puerile in this grave philosopher and calculator, this votary of abstract science, huzzaing in a mixed crowd on a city's holiday. But to me it seems a most natural and beautiful expression of his simplicity, his self-forgetfulness, his utter unconsciousness of greatness, his generous sympathy with the people, and his grateful and ardent patriotism. This little incident cannot fail to raise him in the estimation of every right-minded and single-hearted man.

Dr. Bowditch was a truly conscientious man. He was always true to his moral as well as intellectual convictions, and followed them whithersoever they led. He had great faith in the rectitude of his moral perceptions, and in the primary decision of his own judgment and moral sense; and he carried them forth and acted them out instantly. The word followed the thought, and the deed the feeling, with the rapidity of lightning. This straightforwardness and frankness were among the secret causes of the remarkable influence which he confessedly exercised over the minds and judgments of others. By his honesty, as well as by his resoluteness and decision, he was the main-spring of every thing with which he was connected. By his moral influence he controlled and swayed all men with whom he was associated. As Ben Jonson says of Lord Bacon, "he *commanded* where he spoke."

Dr. Bowditch was a man of ardent natural feelings, and of an impetuous temperament. A venerable lady, after her first interview with him, said, "I like that man, for he is a *live* man." He was strong in his attachment to men and to opinions, and was not easily turned from any course of speculation or action, which he had once satisfied himself was right, wise and good. At the same time, he always kept his mind open to evidence; and if you brought before him new facts and arguments, he would reconsider the subject—deliberately, not hastily—and *the next day*, perhaps, would tell you that you were in the right, and that he had altered his mind. He was sometimes quick, warm, and vehement in expressing his disapprobation of the character or conduct of an individual, particularly if he thought that the person had practiced any thing like duplicity or fraud. In such cases, his indignation was absolutely scorching and withering. But he never cherished any personal resentments in his bosom. He did not let the sun go down upon his wrath. His anger was like a cloud, which passes over the disk of the moon, and leaves it as mild and clear as before; or, as the judicious Hooker's was represented to be, "like a vial of clear water, which, when shook, beads at the top, but instantly subsides, without any soil or sediment of uncharitableness."

Let me relate an incident illustrative of this remarkable trait in his character. Dr. Bowditch had been preparing a plan of Salem, which he intended soon to publish. It had been the fruit of much labor and care. By some means or other, an individual in the town had surreptitiously got possession of it, and had the audacity to issue proposals to publish it as his own. This was too much for Dr. Bowditch to bear. He instantly went to the person, and burst out in the following strain: "You villain! how dare you do this? What do you mean by it? If you presume to proceed any farther in this business, I will prosecute you to the utmost extent of the law." The poor fellow cowered before the storm of his indignation, and was silent; for his wrath was terrible. Dr. Bowditch went home, and slept on it; and the next day, hearing from some authentic source, that the man was extremely poor, and had probably been driven by the necessities of his family to commit this audacious plagiarism, his feelings were touched, his heart relented, his anger melted away like wax. He went to him again, and said, "Sir, you did very wrong, and you know it, to appropriate to your own use and benefit the fruit of my labors. But I understand you are poor, and have a family to support. I feel for you, and will help you. That plan is unfinished, and contains errors that would have disgraced you and me, had it been published in the state in which you found it. I'll tell you what I will do. I will finish the plan; I will correct the errors; and then you shall publish it for your own benefit, and I will head the subscription list with my name."

What a sublime, noble, christian spirit was there manifested! This was really overcoming evil with good, and pouring coals of fire upon the poor man's head. The natural feeling of resentment, which God has implanted within all bosoms for our protection against sudden assault and injury, was overruled and conquered by the higher, the sovereign principle of conscience.

Dr. Bowditch was, in all his habits of life, a very regular and temperate man. He never tasted any wine till the age of thirty-five. He approved the remarkable changes which have been effected in the customs of society, within a few years, by "the temperance reform," and he heartily rejoiced in the success of that good cause. God bless it and speed it!

In his religious views, Dr. Bowditch was, from examination and conviction, a firm and decided Unitarian. His parents were Episcopalians, and he himself had been educated in the tenets of that church. But he had no taste for the polemics or peculiarities of any sect, and did not love to dwell on the distinctive and dividing points of christian doctrine. His religion was rather an inward sentiment, flowing out into the life, and revealing itself in his character and actions. It was at all times, and at all periods of his life, a controlling and sustaining principle. He confided in the providence and benignity of his Heavenly Father, as revealed by his blessed Son, our Lord, and had the most unshaken confidence in the wisdom and rectitude of all the divine appointments. He looked forward with firm faith to an immortality in the spiritual world.

He said to one, in his last illness, "From my boyhood my mind has been religiously impressed. I never did or could question the existence of a Superintending Being, and that he took an interest in the affairs of men. I have always endeavored to regulate my life in subjection to his will, and studied to bring my mind to an acquiescence in his dispensations; and now, at its close, I look back with gratitude for the manner in which he has distinguished me, and for the many blessings of my lot. I can only say, that I am content, that I go willingly, resigned, and satisfied." To another he said, "I cannot remember when I had not a deep feeling of religious truth and accountableness, and when I did not act from it, or endeavor to. In my boyish days, when some of my companions who had become infected with Tom Paine's infidelity, broached his notions in conversation with me, I battled it with them stoutly, not exactly with the logic you would get from Locke, but with the logic I found *here*, (pointing to his breast,) and here it has always been, my guide and support; it is my support still. My whole life, has been crowned with blessings beyond my deserts. I am still surrounded with blessings unnumbered. Why should I distrust the goodness of God?

Why should I not still be grateful and happy, and confide in his goodness?"

Dr. Bowditch was very familiar with the Scriptures, both of the Old and New Testaments, more so than some professed theologians who make it their special study. He had read the Bible in his childhood, under the eye of a pious mother, and he loved to quote and repeat the sublime and touching language of Holy Writ.

Such had been the life, and such the character of this distinguished man; and such was he to the last, through all the agonies of a most distressing illness. In the midst of health and usefulness, in the full discharge of the duties of life, and in the full enjoyment of its satisfactions, the summons suddenly comes to him to leave it. And he meets the summons with the utmost equanimity and composure, with the submission of a philosopher and with the resignation of a Christian. He certainly had much to live for—few have more—but he gave up all without repining or complaint. He said he should have liked to live a little longer, to complete his great work, and see his younger children grown up and settled in life. "But I am perfectly happy," he added, "and ready to go, and entirely resigned to the will of Providence." He arranged all his affairs, gave his directions with minuteness, and dictated and signed his last will and testament. While his strength permitted, he continued to attend to the necessary affairs of his office, and on the day previous to his death, put his name to an important instrument. In the intervals of pain, he prepared, as I have already remarked, the remaining copy, and corrected the proof-sheets, of the fourth volume of his great work, the printing of which was nearly finished at the time of his death. It is a little remarkable that the last page that he read was the one thousandth. It was gratifying to him to find that his mind was unenfeebled by disease and pain; and one day, after solving one of the hardest problems in the book, he exclaimed, in his enthusiastic way, "I feel that I am Nathaniel Bowditch still—only a little weaker."

He continued, indeed, in all respects, the same man to the last. He did not think that this was the time to put on a new face or assume a new character. His feelings were unaffected, his manners unchanged, by the prospect before him. He seemed to those about him only to be going on a long journey. To the end, he manifested the same cheerfulness, nay pleasantry, which he had when in health, without, however, the least admixture of levity. In his great kindness, he exerted himself to see many friends, every one of whom, I believe, will bear testimony to his calm, serene state of mind. The words which he spoke in those precious interviews, they will gather up and treasure in their memory, and will never forget them so long as they live. She certainly will not, to whom, when on her taking leave of him she had said "Good night," he replied, "No, my dear, say not 'Good night,' but 'Good morning,' for the next time we meet will be on the morning of the resurrection."

One day, toward the close of his lingering illness, after he had himself given up all hope of recovery, he asked one who stood by him, what were the two Greek words which signify "easy death." The word not immediately suggesting itself to the person, and he having mentioned over several phrases and combinations of words, Dr. Bowditch said, "No, you have not got the right word; but you will find it in Pope's Correspondence." The person found the letter, which was the last that Dr. Arbuthnot* wrote to his friend. The conclusion of it is as follows: "A recovery, in my case, and at my age, is impossible. The kindest wish of my friends is *euthanasia.*" On hearing this read, Dr. Bowditch said, "Yes, that is the word, *euthanasia.* That letter I read forty years ago, and I have not seen it since. It made an impression on my mind which is still fresh. It struck me, at the time I read it, that the good physician who wrote it would certainly have an easy death. It could not be otherwise. The excellent, the virtuous, must be happy in their death." He afterwards frequently recurred to this subject, and the day previous to his departure, he said, "This is, indeed, *euthanasia.*"

Through the whole of his illness he manifested the same happy and delightful frame of mind. His room did not appear like the chamber of sickness and dissolution. The light of his serene and placid countenance dispelled all gloom, and his cheerful composure robbed death of all its bitterness and anguish. He exemplified in his own case the sentiment so beautifully expressed by the Persian poet, which he loved to repeat:—

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* Dr. Arbuthnot was an eminent physician and brilliant wit in the time of Queen Anne, the contemporary and friend of Swift and Pope. He died in 1735. Dr. Johnson, in his Life of Pope, says of him, "Arbuthnot was a man of great comprehension, skillful in his practice, versed in the sciences, acquainted with ancient literature, and able to animate his mass of knowledge by a bright and active imagination; a scholar, with great brilliance of wit; a wit, who, in the crowd of life, retained and discovered a noble ardor of religious zeal; a man estimable for his learning, amiable for his life, and venerable for his piety."

> "On parent knees, a naked, new-born child,
> Weeping thou sat'st, whilst all around thee smiled:
> So live, that, sinking in thy last, long sleep,
> Calm thou may'st smile, when all around thee weep."

He did not wish to see those about him look sad and gloomy. On one occasion he said, "I feel no gloom within me; why should you wear it on your faces?" And then he called for Bryant's Poems, and desired them to read his favorite piece, "The Old Man's Funeral."

> "Why weep ye then for him, who, having won
> The bound of man's appointed years, at last,
> Life's blessings all enjoyed, life's labor's done,
> Serenely to his final rest has passed?"

And then he went on and commented on the remaining lines of the poem, pointing out those which he thought were descriptive of himself, and modestly disclaiming others that were commendatory, as not belonging to him; but which all impartial persons would unite in saying were singularly applicable to his character.

On the morning of his death, when his sight was very dim, and his voice was almost gone, he called his children around his bedside, and arranging them in the order of age, pointed to and addressed each by name, and said, "You see I can distinguish you all; and I now give you all my parting blessing. The time is come. Lord, now lettest thou thy servant depart in peace, according to thy word." These were his last words. After this, he was heard to whisper, in a scarcely audible tone, the words "pretty, pleasant, beautiful." But it cannot be known, whether he was thinking of his own situation as pleasant, in being thus surrounded at such a time by those he loved, or whether he "snatched a fearful joy" in a glimpse of the spiritual world. Soon after this, he quietly breathed away his soul, and departed. "And the end of that man was peace." Such a death alone was wanting to complete such a life, and crown and seal such a character. He died on Friday, the 16th day of March, having nearly completed his 65th year.

The disease of which Dr. Bowditch died was found, by a *post mortem* examination, to be a schirrus in the stomach, a disease of the same type with that which caused the death of Napoleon Buonaparte. For four weeks previous to his death, he could take no solid food, and hardly swallowed any liquid. He suffered, however, but little from hunger, but constantly from thirst; and the only relief or refreshment he could find, was in frequently moistening his lips and mouth with cold water. His frame was consequently exceedingly attenuated, and his flesh wasted away. At intervals his sufferings were so intense, that, as he said, the body at times triumphed over the spirit; but it was only for a moment; and the spirit resumed again and retained its natural and legitimate sovereignty.

He was buried, as he had lived, privately, and without parade or show, on the quiet morning of the Lord's day.* His funeral was attended only by his family and two others; yet, in the person of the Chief Magistrate, I fancied I saw the Spirit of the Commonwealth doing homage to the talents and virtues of her illustrious son. As the hearse passed along through the silent streets, bearing that precious dust to its last resting-place, the snow-flakes fell upon it, the fit emblems of his purity and worth. And many a wet eye, in the city of his adoption, and in the place of his nativity, and elsewhere, wept for him, and many a heart blessed his memory, and mourned that a friend, and a benefactor, and a good man, had departed.

He has built his own monument, more enduring than marble; and in his splendid scientific name, and in his noble character, has bequeathed to his country the richest legacy. The sailor traverses the sea more safely by means of his labors, and the widow's and the orphan's treasure is more securely guarded, in consequence of his care. He was the Great Pilot who steered all our ships over the ocean; and, though dead, he yet liveth, and speaketh, and acteth, in the recorded wisdom of his invaluable book. The world has been the wiser and the happier that he has lived in it.

He has left an example full of instruction and encouragement to the young, and especially to those among them who are struggling with poverty and difficulties. He has shown them that poverty is no dishonor, and need be no hindrance; that the greatest obstacles may be surmounted by persevering industry and an indomitable will. He has shown them to what heights of greatness and glory they may ascend, by truth, temperance, and toil. He has proved to them that fame need not be sought for solely in political life; although that is a worthy field, and the country must be served,—and served, too, not by the worst but by the best of men,—not by the factious, the ignorant, the scheming, but by the wisest, the most enlightened, the best accomplished, that we have among us; by men who dare to tell the people of their duties as well as of their rights; and who, instead of meanly flattering them for their votes, will boldly speak to them the words of truth and soberness, and point out to them their errors and faults.

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* "Funus, sine imaginibus et pompâ, per laudes ac memoriam virtutum ejus celebre fuit."—*Tacitus, Ann. Lib.* II. § 73.

Above all, Dr. Bowditch has left us a most glorious and precious legacy in his example of integrity, love of truth, moral courage, and independence. He has taught the young men here, and the world over, that there is nothing so grand and beautiful as moral principle, nothing so sublime as adherence to truth, and right, and duty, through good report and through evil report. He has, indeed, blessed the world greatly by his science and his practical wisdom; but quite as much, nay, far more, I think, by his upright and manly character. He has taught mankind that reverence for duty, and trust in Providence, and submission to His will, and faith in the rectitude of all His appointments, and a filial reliance upon His love, are sentiments not unworthy nor unbecoming the greatest philosopher. For this we honor and eulogize him; not for wealth, title, fortune, those miserable outsides and trappings of humanity, but for the qualities of the inner man, which still live, and will live forever. He studied the stars on the earth—may he not now be tracking their courses through the heavens? Long ere this, perhaps, he knows all the beauties and the mysteries of their tangled mazes—has examined the rings of Saturn and the belts of Jupiter, traversed the milky way, and chased the comet through infinity. Methinks I hear his departing and ascending spirit exclaiming, as it wings its flight upwards, in the language of the beautiful hymn:—

"Ye golden lamps of heaven! farewell,
With all your feeble light:
Farewell, thou ever-changing moon,
Pale empress of the night!

And thou, refulgent orb of day!
In brighter flames arrayed,
My soul, which springs beyond thy sphere,
No more demands thine aid.

Ye stars are but the shining dust
Of my divine abode,
The pavement of those heavenly courts,
Where I shall reign with God.

The Father of eternal light
Shall there his beams display;
Nor shall one moment's darkness mix
With that unvaried day."

## DR. BOWDITCH'S SCIENTIFIC PAPERS.

The following is a list of the Papers contributed by Dr. Bowditch to the Memoirs of the American Academy of Arts and Sciences. It will serve to show the extent of his observations and the variety of his inquiries.

### VOL. II.

New Method of Working a Lunar Observation.

### VOL. III.

Observations on the Comet of 1807.

Observations on the Total Eclipse of the Sun, June 16, 1806, made at Salem.

Addition to the Memoir on the Solar Eclipse of June 16, 1806.

Application of Napier's Rule for solving the cases of right-angled spheric trigonometry to several cases of oblique-angled spheric trigonometry.

An estimate of the height, direction, velocity and magnitude of the Meteor that exploded over Weston, in Connecticut, Dec. 14, 1807.

On the Eclipse of the Sun of Sept. 17, 1811, with the longitudes of several places in this country, deduced from all the observations of the eclipses of the Sun, and transits of Mercury and Venus, that have been published in the Transactions of the Royal Societies of Paris and London, the Philosophical Society held at Philadelphia, and the American Academy of Arts and Sciences.

Elements of the orbit of the Comet of 1811.

An estimate of the height of the White Hills in New Hampshire.

On the variation of the Magnetic Needle.

On the motion of a pendulum suspended from two points.

A demonstration of the rule for finding the place of a Meteor, in the second problem, page 218 of this volume.

### VOL. IV.

On a mistake which exists in the solar tables of Mayer, La Lande, and Zach.

On the calculation of the oblateness of the earth, by means of the observed lengths of a pendulum in different latitudes, according to the method given by La Place in the second volume of his "Mécanique Céleste," with remarks on other parts of the same work, relating to the figure of the earth.

Method of correcting the apparent distance of the Moon from the Sun, or a Star, for the effects of Parallax and Refraction.

On the method of computing the Dip of the Magnetic Needle in different latitudes, according to the theory of M. Biot.

Remarks on the methods of correcting the elements of the orbit of a comet in Newton's "Principia," and in La Place's "Mécanique Céleste."

Remarks on the usual Demonstration of the permanency of the solar system, with respect to the Eccentricities and Inclinations of the orbits of the Planets.

Remarks on Dr. Stewart's formula, for computing the motion of the Moon's Apsides, as given in the Supplement to the Encyclopædia Britannica.

On the Meteor which passed over Wilmington in the State of Delaware, Nov. 21, 1819.

Occultation of Spica by the Moon, observed at Salem.

On a mistake which exists in the calculation of M. Poisson relative to the distribution of the electrical matter upon the surfaces of two globes, in vol. 12 of the "Mémoires de la classe des sciences mathématiques et physiques de l'Institut Impérial de France."

Elements of the Comet of 1819.

Dr. Bowditch was also the author of the article on Modern Astronomy, in the North American Review, Vol. XX. pp. 309—366. In the Monthly Anthology, Vol. IV. p. 653, there is a brief account of the Comet of 1806, drawn up by him at the request of the Editors.

## Art. II.—*Cursory Remarks upon East Florida, in* 1838; by Maj. Henry Whiting, U. S. Army.

Public attention has most naturally been turned towards Florida for the last two or three years. That peninsula has been the scene of a contest of remarkable character, awakening a curiosity respecting its topography, resources, &c. which has found but scanty means of gratification. Although the first portion of the United States to be permanently occupied, (St. Augustine having been founded in 1564,) and early signalized by political revolutions, military events, and romantic enterprises, yet its history, both statistical and natural, has been but imperfectly understood by us. The Spaniards no doubt had a tolerably accurate knowledge of the interior, which was formerly somewhat extensively occupied by them. Their settlements, however, were much broken up during the insurrectionary movements which immediately preceded the transfer of jurisdiction to the United States, and the majority of them, when that transfer took place, were abandoned, under the influence of strong national prejudices, which led to a distrust or dislike of a new and dissimilar government. Much local information was thus withdrawn. St. Augustine in the east and Pensacola in the west, with some few subsidiary plantations, were all the settlements that came into our possession. The rest was nearly an unoccupied waste. Even a knowledge of the St. John's, the grand artery of the country, had nearly passed away; so much so, that at the commencement of the present campaign (1837–8) the form, extent, and depth of its upper waters were unascertained.

The war which has lately been carried on with the Florida Indians has opened the country generally to observation, and its character will hereafter be better, if not well understood. Our troops have traversed it in almost every direction; nearly all parts have been explored, excepting the interior of the lower parts of the peninsula south of the Okachobee Lake. From the 26th degree of latitude northward, the geography may be laid down with general accuracy. Indeed, United States maps of this character are already in the hands of some of our officers, which will no doubt soon be lithographed.

The river St. John's was early entered into both by the French and the Spaniards, the rise and fall of whose establishments there form an interesting and sanguinary portion of history. At the present time (1838) there is scarcely a dwelling occupied on either of its banks fifty miles above its mouth, though many evidences of former occupancy, such as falling buildings, or fields bearing the marks of having been cultivated, are seen some hundred miles higher up. Many of these farms or plantations were abandoned by the Spaniards at the change of jurisdiction; others were the work of Americans at a later date. But all had shared a common fate at the opening of the present contest. The Indians burnt all the buildings and plundered and massacred all the inhabitants that were not defended by a garrison, and desolation is now seen, where, a few months since, were sugar fields, cotton fields, orange groves, and many other proofs of a thriving population.

This river (St. John's) is in most respects of a remarkable character. It is unlike most if not all of the rivers in North America, having little current at any point of its course, and passing through a country, from its very source, so level in its surface, as scarcely to warrant the expectation of any stream at all. At low stages of the water there is no visible current even in the upper parts of the river, though at high stages it is visible, having perhaps a movement of one mile an hour. Below Lake George, which is more than two hundred miles from its mouth, the tides have a slight effect, and vary the current accordingly, modified, however, by strong winds. Still, the waters have not any where a stagnant appearance, and if unpalatable, they are so from causes independent of their want of proper agitation. They are uniformly of a dark color, like that of tolerably strong coffee, the bottom scarcely being discoverable even in the shoal parts. The origin of this tint may be various; decomposition of vegetable matter can contribute but little to affect a body of water so large, particularly when a considerable portion of the banks are either savannas or pine bluffs, neither likely to have much agency in this way. Lake Monroe may furnish a chalybeate tincture, as its shores abound in chalybeate earths. The lakes above may bear the same character. The waters do not lose their color when suffered to stand in a vessel and to make deposit of such particles as may be afloat in them.

The St. John's is a large river for some hundred and fifty miles from its mouth, being from three miles to a mile wide nearly as high as Lake George. Thus far it has the appearance of an arm of the sea, and in fact feels the influence of the tides. From Lake George upwards it is comparatively narrow, excepting where it dilates into lakes, and very winding, running perhaps several miles in one mile of a straight line. Lake George has been long known, and Lake Monroe, about sixty miles above, was occupied by our troops the first campaign of the present war. Thence upwards the river was to be explored at the commencement of the present campaign. It was soon penetrated through Lake Jesup to Lake Harvey, and afterwards to Lake Poinsett, about a hundred miles above Lake Monroe.

Charleston and Savannah steamboats ascended with army supplies without difficulty, at the high stage of the waters, to Lake Harvey, which supplies were sent thence by row-barges to Lake Poinsett, where the river ceased to be subservient to the purposes of transportation. This high stage was in the fall; as the winter months set in, the larger boats could ascend no higher than Lake Monroe, until spring rains again raised the level of the waters.

The banks of the river as high as Pilatka, or more than one hundred miles from its mouth, are generally elevated several feet above the water. From that point to Lake George they are comparatively low, and are probably mostly submerged at high stages of the water. Between Lake George and Lake Monroe the banks are generally high enough to be dry, excepting where savannas prevail. Wherever the pine-barrens strike upon the river, the banks are eight or ten feet high, with a substratum of shelly soil or rock. To Lake Monroe they are for the most part clothed with a growth of wood—chiefly live oak, pines, and cypress, as high as Lake George; the palmetto or cabbage tree, being largely intermixed thence upwards.

The grey moss clothes nearly all the trees upon the river, excepting the pine and palmetto. These are respected or avoided by this general associate of the trees, from some want of affinity which may not be understood. This moss is a most singular production, having a rank luxuriance little according with its kindred species. It hangs from every bough many yards in length, and wears the appearance at a distance of dingy muslin thrown with a careless grace over every part of the tree, waving to and fro in the breeze and forming a most striking embellishment of the scene; and the effect is not diminished by the presence of the tall and symmetrical palmetto, which rises up some forty or fifty feet perpendicular, like a perfectly wrought column, surmounted by a capital of most appropriate beauty. The moss never throws its foldings over this handsome tree; as we have before remarked, the pine is equally avoided by it. This capricious forbearance with respect to these two kinds of trees, introduces a beautiful variety into the river scene. Where the banks are high and sandy, the pine prevails; where they are low and wet, the cypress—"the melancholy cypress." The live oak, and other miscellaneous trees, prefer the banks of an intermediate character, as also the palmetto. The cypress seems to exclude all associations; no other trees mingle with it, or if they happen to start up along side they are soon overshadowed above by the spreading tops, or crowded out by the cone-like bases below, which last leave only room for the thousand "knees," or sharp excrescences, from one to several feet high, which shoot up like so many dwarf pinnacles.

Ascending the river, which is constantly winding and shifting the point of view, wherever the cypress permits, there the moss is seen in all its sweeping luxuriance. As these trees spring from nearly a water level, and grow to about an equal height, their flat and spreading tops present nearly a horizontal line, where the green appears in all its depth and freshness. Thence, however, to within a few yards of the ground, the folds of moss, like ample curtains, conceal nearly all from view, leaving the trunks exposed below, which are covered with a whitish bark. This aspect may prevail for half a mile, when the banks may rise and become covered with the live oak, whose angular and scraggy arms give a new appearance to the moss, which is still as luxuriant as on the cypress. But the outline above is far different here. Palmettos perhaps raise their graceful heads above the oaks in striking contrast with their associates; or perhaps the pine may show in the barren beyond; while over all is the clear azure of the sky, always in Florida

> "So purely dark, and darkly pure."

These changeful beauties, combined with the occasional sight of a wild orange-grove, with its golden fruit bespangling the foliage, altogether render a trip up the St. John's delightful in a high degree.

The ash, poplar, swamp oak, &c., which line the banks of a part of the upper St. John's, drop their leaves during the winter months, unlike all the other trees to which we have been alluding. But these trees would seem to be deciduous, to exhibit more plainly the verdant parasite which attaches itself to most of their branches. In passing up the river for the first time, the uninstructed gazer is surprised and puzzled to see on all these trees a tuft of evergreen, while the branches in general are stripped of their foliage, until informed that it is the mistletoe, which, having attached itself thus to a foreign stock, continues to smile in verdure, while its supporter is standing in gloomy nakedness. The mistletoe bough is always of a rounded form, varying in size from a few inches to thirty or more in diameter. The seeds, which are said to be winged, have a gluten surrounding them, which enable them to attach themselves where they alight and at once to draw forth nourishment as if fixed to a parent stem. The *nullius filius* of the forest, it is adopted by the first tree to which it flies for protection and sustenance.

Sulphur springs are very abundant on the upper parts of the St. John's. They bubble up like *jets d'eau.* In passing up to Lake Monroe, there is one a few miles below, which attracted, among others, the notice of Bartram. An inlet on the right bank is seen, nearly of the width of the river, which at once attracts the eye, by the contrast between the color of its waters and that of the river. Two pieces of lumber, placed at right angles with each other, one of mahogany and the other of yellow pine, could not be more dissimilar. And the liquid line of separation is almost as distinct as it would be in the supposed case. The St. John's has here, as elsewhere, its coffee-like hue, while the waters of the sulphureous inlet are as transparent as the air, the fishes swimming in them being nearly as discernible as the birds flying over their surface. The alligators, diving, as usual, at the approach of a boat, when they happen to take refuge in this limpid inlet, continue to struggle downwards in apprehension, as if they felt that it did not afford the usual refuge.

Ascending this inlet several hundred yards, it is found to terminate in a well head or basin, of some thirty feet diameter, with high banks, in the centre of which there is a prominent turmoil of the waters, as if a fountain below threw up its contents with much force. Rowing the boat upon this agitated spot, it was with difficulty kept there in its position, against the efforts of the ebullition to throw it off. A strong odor of sulphur fills the air around, and the taste of the waters is equally sulphureous.

Above Lake Monroe, wide-spread savannas become prevalent. They form the main body of the section of country through which the St. John's flows, and are so slightly inclined, that its course is extremely tortuous, the bends having more the shape of a horse shoe, than of a segment of a circle. The immediate banks in these savannas are somewhat elevated above the level of the waters, as the growth of a wild cane indicates, but the greater portion of them bear a tall, rank grass, which shows that it is often inundated, and that the soil is constantly saturated with moisture. Lakes George, Monroe, Jesup, Harvey and Poinsett, are fine sheets of clear water, of no great depths, but generally free from aquatic vegetation. They all abound in fish and wild fowl.

Fort Taylor, (a mere stockade, like all the other forts in Florida of recent origin,) which was built a few miles above Lake Poinsett, three hundred and fifty miles or more from the mouth of the St. John's, is the highest point to which the army boats ascended. Above that post, the river narrowed and shoaled, so as to become useless for all purposes of transportation. The army there took its course southwardly, reaching the head waters of the St. John's, some seventy or eighty miles S. S. E. The source of this river has been in question up to this time, having been supposed to be connected either with the everglades or the sea. Both of these suppositions are now at an end. The strip of land between the coast and the St. John's, as far south as Cape Florida, has been sufficiently explored, to determine the fact, that it has no channel connection with the sea in that quarter; and it has been equally ascertained, by various army movements, that it is also without a like connection with the everglades or the lakes, to the west and south-west. In rainy seasons, when the water overspreads nearly the whole country, the St John's may be connected in a diffused way with both sides. Fall and spring rains, when they come, elevate the river sometimes many feet, as would appear by marks on the banks. The last two or three seasons, the difference has been from two to three feet. The low stages are, at mid-summer and mid-winter, and when the periodical rains happen to fall, or are only moderate, the subsidence must be very great. It has been remarked by the Indians, that all the waters occasionally drain out. This may be an exaggeration; but such a result, nearly to the extent expressed by it, might easily be supposed to follow a year of drought, the St. John's being evidently dependent for its supply on the tides below and the rains above.

The interior of Florida, south of Lake Monroe, was scarcely known, until the present war. It was assigned by conjecture and common report, to the "everglades," an indefinite and comprehensive term, which means neither land nor water, but a mixture of both. These supposed everglades, have been much circumscribed by late examinations. They have lost, at least, one or two degrees of latitude. Okachobee Lake, a body of water of some forty miles in diameter, and of a decided lake character, and the lands east and west of it, can no longer be thus classed. The lake south of this, reported to be still larger than Okachobee, called by the Indians, Pai-hai-okee, or grassy lake, may prove, on examination, the true everglades. But it is now about as probable, that even this, their last hold, will be found to partake of the general character of that part of the peninsula, and that land and water will then have its usual divisions, so far as a sandy country of unusual flatness permits. The name which the Indians have given the lake, shows that it must be generally so shallow as to allow grass to predominate; rendering it probable, that it has a less decided lake character than the lakes above.

It was until lately taken for granted, that the interior of Florida was without any eminent parts, but the army movements have opened to observation, some sandy ridges or hills of considerable elevation. These are not far from that central region where the waters diverge to different sides of the peninsula. The course of the various streams which take their rise within these central parts, marks out the character of the slope, running north-west, south-west, south-easterly and northwardly. The Onithlacoochee, Pease Creek, Kissimmer, St. John's, and the waters emptying into the Indian River lagoons, all illustrate this central elevation, and general inclination towards the coast.

One of the striking features of the coast of Florida, is the lagoons, as they are termed, or long and narrow bodies of water, separated from the sea by a strip of sand, generally not more than a mile or two wide. They are connected with the sea here and there by inlets, which are made and kept open by the out-rushing or in-rushing tides, as they happen to prevail. The outward current is that which chiefly prevails, from the most natural causes. Accumulations from rains, must give a great preponderance to the inner waters, which, however, may, in the course of a dry season, drain out to a level with the outer waters, when the drift of a storm blocks up, at least for a time, the usual passage, and so it remains until the balance of force is turned by new rains.

This alternate operation of counter causes, explains the fact well known by those who frequent this coast, that these inlets are at one time very accessible, and at others, nearly or quite closed up. These lagoons extend from above St. Augustine to Jupiter inlet, a stretch of three or more hundred miles, with but a few miles interruption by land. Their common depth is several feet, though they all are traversed by shoals or bars, which reduce their navigable facility to about three feet. These shoals, however, could easily be made passable for useful purposes. It has been proposed to connect the river St. John's by a canal with the Matanzas river, separated by about ten or fifteen miles; the Matanzas with the Halifax, twice that distance, perhaps, apart. Between the waters of which the Musquito inlet is the embouchure, and those of the Indian River, there is only a narrow neck of about half a mile. Such a project would open an interior navigation from Charleston to Jupiter inlet; and below Cape Florida it is well known that a practicable and sheltered channel runs around the peninsula, within the "keys."

The mangrove tree is a conspicuous embellishment of the Indian River lagoon. Being of an aquatic character, these trees, by a happy provision of nature, are radicated to suit their thrifty habits, not unlike the long-legged species of birds which are fitted for the water; they stand with their trunks lifted several feet in the air, sending out roots from that elevated point, like so many bow-legs, to seize the earth or water below, with a base often as wide-spread as the branching head above. Then, again, as if these roots could not drink moisture enough to satisfy their cravings, each branch sends down many a slender tube perpendicularly to the water, like so many syphons to draw it up. The foliage is of the brightest green. Altogether, a mangrove thicket is a most attractive object to the eye. These thickets sometimes shoot out a spur into the lagoon, resembling just above the water a fisherman's weir-net, but surmounted by a most redundant foliage, and almost closing up the channel.

The bars at the mouths of the lagoons are an obstruction to the commercial facilities of Florida. The entrance to St. Augustine harbor is perhaps the best on the coast, and, with proper attention to the tides and winds, is safely practicable for vessels of light draft. The drift of the ocean, which in this quarter is strongly charged with alluvion, heaps up the sands along the coast, constantly changing their position, with, probably, a gradual augmentation. The inlets would share the common fate, and be closed up, if it were not for the outsetting currents, arising either from the tides, or the accumulation of waters within. These causes, with partial exceptions, keep open a channel, but cannot preserve it in one place. The bar off St. Augustine has widely shifted, being now nearly one half the points of the compass to the north of its position, within the memory of living pilots. Those of the more southern inlets are less practicable, excepting that of the Musquito. The channels are known only to those who are habitually upon them. A fearful looking surf is always coursing over them, when a wind is blowing with freshness, which renders them formidable to strangers, while those who are accustomed to them, pass through it with little real hazard. The evil, however, is a great one, and apparently irremediable.

The rivers of Florida, though of no great length, are, generally, of a most convenient depth. The banks are bold and firm. Those which empty into the lower part of the St. John's, are fitted for any craft that comes into the main river, or have no impediments in the way, excepting what arise from fallen trees. There is no current to change their character, which belongs to a level country.

The botany of Florida was early examined by the Bartrams, and Audubon was some time among its birds, which are rich in number and variety. Many anecdotes are told of the latter, showing the patience with which he kept his station in swamps and marshes, in order to ascertain the habits of the feathered creatures there, in spite of musquitoes, reptiles, and other intolerable annoyances. Doct. Leitner, who was killed in a skirmish with the Indians, this campaign, (1838,) is said to have been a skilful botanist, and an ardent votary of science. Accompanying a portion of the active force, he would have had uncommon opportunities for observing the plants of the southern interior, which probably, came little within the scope of the Bartrams, whose investigations were mostly, if not altogether, on the river St. John's and the coast. He had already made considerable advances towards the object he had in view, with a most flattering prospect before him, when he fell in the honorable performance of his duty.

The orange tree has been extensively cultivated in Florida, since its first occupation. The Seville or sour, and bitter-sweet orange, are apparently indigenous to the country, as many groves of both are now found flourishing, where no labor of man would seem to have placed them. The China, or sweet orange, is probably an exotic. These were found, not only around nearly every house in the country, but occupying a part of nearly every garden in the towns. They were an important article of commerce. The oranges of Florida excelled all others in the northern markets. More than two millions, were annually shipped from St. Augustine alone. One tree there is said to have produced six thousand in one year. But this staple of the country was cut down in one night, in 1835. A severe frost occurred in the time of Bartram, (1765,) which killed the lemon, citron, and other tender trees, but only partially injured the orange. There were trees standing in 1835, more than a century old.

This calamitous event, besides destroying one of the principal sources of revenue of St. Augustine, divested the place of its chief ornament. Each lot became, as it were, denuded of its drapery, which had been thrown over every building, high and low, giving them all a borrowed beauty. A person who was absent at the time of the frost, in revisiting the place, could scarcely recognize the most familiar scenes, their aspect was so entirely changed. It takes about seven years to renew the orange tree to a bearing state.

Cotton and sugar grow well in Florida, but silk will probably be the staple of the country after a few years. The mulberry tree, multicaulis, &c., grow there with a vigor and luxuriance that have no parallel in the United States. More than eight months in the year afford a fullness of food for the worms.

The soil of Florida wears a forbidding aspect. Sandy barrens form the principal part of the surface. Hammock land, that which bears the oak, maple, and other "hard woods," and which are the richer and more productive parts, constitutes but a small proportion. But the sands of Florida are but in part siliceous. They are probably for the most part comminuted shells or limestone. Hence they have a degree of fertility which often surprises those who undertake their cultivation. The surface, however, is so level, that it is liable to the extremes of drought and inundation. In riding from the St. John's to St. Augustine, a distance of eighteen miles, the road will be found, after a moderate rain, one half or two thirds under water, which is carried off more by evaporation than by subsidence; and this is a sample of the country in general.

The yellow pine, Pinus palustris, is a conspicuous tree in Florida, both on account of its lofty symmetry, and its adaptation to many useful purposes. It affords tar and turpentine in inexhaustible abundance, and is an equally inexhaustible material for lumber. Whether it be the only growth the soil can yield, or merely a pre-occupant, as in many other parts of the country, giving place, when removed, to a species of hard wood, is, perhaps, not yet ascertained. It is probable, however, that when this tree shall be cut down, and fires, scorching the whole face of the country, shall cease, the growth of the forest lands will assume a better aspect, and that the soil will improve in a corresponding degree. It is the fallen tree of this pine, which furnishes the Indian with his "light-wood;" a source of comfort and convenience that strongly attaches him to the soil which produces it. The fuel formed from these prostrate trunks, is at hand on every spot, and is easily ignited, making, in all weathers, a bright and durable fire. The nights of Florida are almost invariably cool, and the facility with which the Florida Indian can temper their chilliness, by means of this ready and combustible wood, is a conspicuous item in the privileges of his life, the great design of which is to attain desirable objects with the least effort. Our troops, in the late campaigns, have been equally indebted to it for many a comfortable encampment, as, even in the midst of heavy rains, a brilliant fire might be kindled, which, with due care, no rains could extinguish.

The hammocks at present are generally secure from encroachment from the barrens, being mostly covered with a dense growth of trees, which preserves them from change. But, whenever the time arrives in which they shall be cleared up, and become exposed to external influences, it is not unlikely that the surrounding barrens, clothed in a soil of such levity as to be acted upon by winds and rains, will gradually overspread these comparatively small spots on the surface of the country, and reduce nearly the whole to one general character.

The waters of Florida abound in fish. Even the upper parts of the St. John's afford a large supply of very tolerable quality. But the lagoons of the coast have not only an abundance of the finest fish, but also of the finest oysters. The oysters of Indian river are surpassed by none, in size or quality, on the Atlantic coast. Want could never approach the inhabitants of that region.

The present war, during which the Indians have been too much harassed to attend to seed-time or harvest, has turned attention to the class of indigenous esculent vegetables, which, by their spontaneous abundance, have, through the extremities of this period, afforded them ample means of subsistence. The most conspicuous among these are the red and white coonta roots. The first is the China-briar, or *Smilax china*, a vine of great thriftiness, spreading sometimes over the space of more than a hundred feet, with roots like a large, long and irregular potatoe. The white coonta is the *Zamia integrifolia*, which has a full tap-root, rounded with the symmetry of a boy's top. The leaves are large and fern-like, forming, when the seed-bud is in its fullness, a handsome plant.

Both of these roots are grated or bruised by the Indians, and the starch separated, by frequent changes of water, from the fibrous or woody parts, as also, in the white coonta, from a poisonous quality which is combined with it in its natural state. The flour of the latter has the look and feel of arrow-root, and is equally nutritious and well suited to weak stomachs. The flour of the China-briar is of a reddish hue, and more easily obtained than the white coonta.

These two important articles of food are found in abundance, the one or the other, in most parts of southern Florida; the China-briar in nearly all the hammocks, and the Zamia in most of the barrens along the coast lagoons. Thousands could subsist upon them, with only the labor necessary to gather the roots and prepare the flour. Previous to the war, one or two persons were established near Cape Florida, who manufactured the white coonta in large quantities for shipment. Medical men often prefer it, for hospital purposes, to the arrow-root.

The palmetto is often called the cabbage-tree, from its containing an edible substance within its top, which somewhat resembles a cabbage—more in look, however, than in taste, which is not unlike that of a raw chestnut. Where the fan-shaped leaves of this beautiful tree put out at the top, is found infolded a pith, forming about one third the diameter of the trunk, and about twelve or fifteen inches long, which is of an eatable quality, particularly when boiled, or preserved as a pickle. It is true, a tree some half-century old might be sacrificed to the attainment of a single meal; but these trees are abundant, and no doubt have often afforded one to a roving Indian, who sat down hungry and unprovided beneath their shade.

But the necessities of the war now going on, have opened a new resource to the Indians, or which, at least, does not appear to have been used by them in more abundant times. This is found in the root of the *saw-palmetto*, a singular species of most common vegetation in Florida, which overspreads nearly every pine-barren, covering it like a vast reticulated carpet. In passing over these barrens, the palmetto leaf is seen shooting up from the ground in great luxuriance, forming, as is found on close inspection, the termination of a recumbent cabbage-tree, several feet long, and probably half buried beneath the surface, or deciduous vegetation. Lying constantly on the ground, it never acquires the bony hardness of the exterior coat of the upright cabbage tree, but is covered with a fibrous hairiness, which gives it almost the softness of silken plush, prevailing through every fold, to the very heart, excepting within a few inches of the end, where is found a nutritious pith, smaller than, but not unlike, that of the cabbage tree. This is bruised into meal, and made subservient to the purposes of food. These roots spread, as we have before remarked, over nearly every barren; and, since a portion of them is convertible into food, there can be no limit to the spontaneous subsistence of those who frequent them. The leaves or foldings of this root are thin and pliable, several inches long, and three or four wide, and are worked into many articles of ornament and use.

There is also found in Florida a wild potatoe, of tolerable quality, and much wild fruit. Game of all kinds is abundant, and wild fowls are numerous on every stream and lake. The Indians, in Spanish times, were accustomed to herd cattle largely, and at the commencement of the present war, they are said to have had thousands.

From this enumeration of the articles of food which present themselves spontaneously to the wants of the Indian, it will be seen that they are little dependent on care, foresight, or labor, for subsistence.

The mineralogy of Florida is scanty. The rocks found in situ are all calcareous, though siliceous boulders, of a small size, are occasionally seen, and nodules of hornstone are here and there mingled with the limestone, which elicit sparks, and are sometimes used by the Indians for flints.

The geology of Florida presents many interesting features; but it has as yet been examined with little attention, warranting few definite conclusions. The coast, as far as Cape Florida, is alluvial, a seeming mass of comminuted shells, resting on a rocky formation, composed also of shells, more or less broken and abraded. From Cape Florida, the formation is mostly coralline, the Keys being of that character. The shells around the Keys are found in nearly a perfect state. Take up a handful at random, and it will exhibit little else than fragments of coral and univalves, generally of a small size, and diminishing almost to a point.

As high as Indian River Inlet, the beach is still formed of shells, though less distinct and perfect in their form, mingled with some sand; while about Cape Carnaverel the sand predominates, until shelly fragments almost disappear to the naked eye. Still, it seems probable that the whole beach is of a calcareous character.

The coquina rock (as the Spaniards called it) is a formation found in the spits of sandy land which separate the lagoons near the coast from the sea. It has been quarried in Anastasia island, for more than a century, affording a material for structures of all kinds in St. Augustine, worked with uncommon facility, and of a durable character. A large fort, of Spanish construction, at that place, is of coquina. In latitudes where there is little or no frost, it is, perhaps, the best material that can be used in fortifications; being firm enough to sustain the form of any work, and receiving a shot like a plastic mass, exhibiting no fracture, and throwing off no splinters.

The quarries near St. Augustine are generally about ten feet deep. The profile of the strata, as presented to the eye there, exhibits, first, a superficial covering of vegetable mould; next, a stratum of shelly fragments, quite small, and without any distinctness of character, with no cohesion. This stratum varies much in thickness, according to the undulations of the surface, being generally from two to three feet. The next in the descending series is a stratum of several inches thickness, composed of similar shelly fragments, but united in a mass by some cement. Then intervenes a stratum of sand, an inch or two in thickness. Immediately below this sand is a stratum of shelly rock, between two and three feet in thickness. This stratum is formed of shells in various states, the upper several inches being much like the stratum above, that is, of small and indistinct fragments, when, for several inches more, it assumes a new character, many of the shells being perfect in their outlines, and only much abraded, and most of them of a size to give some clue to their species. The interstices in this portion of the mass are large in proportion to the size of the shells, and the cement which holds them together is hardly visible. Bivalves, cockles, of the cardium species, predominate, while here and there is found a conch of large size, as also oyster fragments. Some of these conchs are several inches in length, though much worn. This coarse and comparatively unbroken deposit has a substratum, with which it is equally closely joined, like that superimposed. A thin stratum of sand next succeeds; and then a third stratum of shelly rock, about two feet and a half thick, the component parts of which are in a state rather more comminuted than any lying above. This stratum is likewise of a more solid and uniform character than its associates, and gives the largest blocks for building purposes. A sandy stratum is found below this, and, so far as an examination has penetrated, the coquina formation descends no lower.

All these strata are firm concretions, their component parts being obviously conglutinated by a calcareous substance, which holds them well together. This foreign substance, or cement, is quite visible in the finer formations, though little seen in the coarser. Taking up a piece of the latter, the cause of cohesion is apparently so slight, that one is surprised that the mass does not crumble at a touch.

It is a common conjecture that the coquina is of recent formation, and that causes are still operating to produce it. This conjecture has some apparent and plausible grounds. It wants, however, the support of deeper investigation into the character and force of these causes. Fragments have been constantly heaping up on the coast, portions of which have been long lying in a quiescent state, without exhibiting any evidences of a change, or a tendency to one, particularly of a change from a loose to a concrete state. The upper stratum of the quarries we have been describing, would be likely to assume the character of the strata below, if such a change were in progress. But the century during which it has been subject to observation, has witnessed no alteration. The fragments all lie in a separated state, without showing any signs of cohesion.

It has been surmised, that the animal matter of the shells might have furnished the element of cohesion. But this surmise would seem to be at once disproved by the condition in which the shells were found, when the concretion took place. It is evident that they must have been subjected to a long and severe process of attrition and contusion, previous to that event; such a process as must have widely separated all animal matter, from its former covering. Besides, there is no reason for supposing, that this animal matter, even if it had existed in connection with the shells at the time the rocky formation occurred, could have produced the effect assigned to it.

A more probable conjecture is, that the shells themselves, by some chemical exertions or agency, which operated in connection with their partial dissolution, furnished the bond of union among the fragments, though not in a way that leaves the same agency still in operation. These different strata are evidently so many distinct deposits, probably at different and distant periods; broken shells thrown up or spread over a certain space, and no doubt converted at equally different and distant periods into solid masses, either by sudden or gradually operating causes, ceasing with their effect. Such a hypothesis is in harmony with our notions of other formations of rock.

There are appearances of shelly formations on the St. John's, particularly the upper parts of it, but the shells are of a different character. Scarcely a bivalve is seen on or near that river, either loose, or in rocky connection. The prevailing shell there, is the Helix, while univalves are as rare in the formations on the coast. The soil at Volusia and Fort Mellon consists of half shells, which are generally perfect in their shape, the defects evidently arising rather from decay than abrasion or contusion.

The limestone does not show itself on the coast, nor on the St. John's until you reach Lake Monroe, where it is intermixed sparingly with shells. On Black creek, west of the St. John's, a porous, rotten limestone appears, and this is said to be the character of the rock formations throughout the western part of the peninsula. Hence the many "surth-holes," deep and (some of them) unfathomable orifices in the earth, which appear in these regions, and the disappearance of streams for many miles beneath the surface of the earth, while others come forth in all their fullness at once.

The climate of Florida, during the six or seven months from October is truly delicious. The frosts are generally few and slight, leaving vegetation its verdure, and flowers their bloom, throughout the year. Such frosts as kill the tender trees or shrubs are of rare occurrence. Rains occasionally prevail during the winter months, but more commonly during the latter part of summer. Our troops have now been operating during three winters. Two of them have been decidedly dry. The first was rainy.

By a loose diary, kept in Florida, since the last October (1837) and continued through two hundred and fourteen days, more than one hundred and fifty of them, were decidedly clear and pleasant days; about forty somewhat cloudy or foggy; and about twenty rainy, but of these nearly one half were single rainy or showery days, leaving only about ten which were of a rainstorm character. Musquitoes have bitten, and frogs have peeped throughout the whole time, though not always in the same numbers or with the same spirit.

It is perhaps a common impression, that there are some formidable animals and many venomous reptiles in Florida. The alligator is a clumsy, timid animal, never, it is believed, the assailant, unless it mistake a swimming boy, for its common prey. Scorpions, snakes, lizards, &c., are common upon the barrens, and our soldiers, in sleeping on the ground, often came in contact with all of them, and were often stung by the former, generally with unpleasant, but never with fatal consequences.

Invalids have long looked to Florida as a refuge from the northern winter, and during the disturbances of the last few years, St. Augustine has necessarily been the only place of resort. But when peace shall be established, and the St. John's re-occupied, that river will present many places of great attraction to the infirm and pulmonic.

## Art. III.—*Geology of St. Croix;* by Prof. S. Hovey, late of the Faculty of Yale College, Ct., and Amherst College, Mass.

During two winters which I passed at St. Croix for the recovery of my health, I found great relief from *ennui*, the well-known natural enemy of invalids in such circumstances, in examining the physical features of the island; and, had my observations been more complete, the record of them might have been a valuable contribution to science. Limited, however, and imperfect as they were, I am unwilling entirely to suppress them; especially, as they relate to a quarter of the world highly interesting, and but little known. Should they be productive of no other benefit, I hope they may lead some more competent individual, who may, perhaps, be driven, as I was, to seek refuge from the rigors of a New England winter, in the balmy climate of the tropics, to continue the examination, and to present to the public the more ample results of his investigations. My object in this article is to give a brief outline of the geology of St. Croix. Should time and health permit, I may, perhaps, on a future occasion, extend my remarks to one or two other islands, and touch on some other topics.

I am not aware that more than two or three of the West India islands have attracted the attention of any geological observer. Indeed, the tropical countries in both hemispheres must yet be regarded, so far as geology is concerned, as nearly a *terra incognita.* Still, they will no doubt furnish highly important results in this interesting science. Here some of its most specious theories will be tested; and here, too, will be found entombed new races of organized beings, brought into existence and advanced to maturity, and finally destroyed, in circumstances differing from any present or past in other parts of the globe. If the axis of the earth has been changed, as some philosophers maintain, here we shall find the evidence of it, in a change of organic remains, corresponding with that in the northern regions, but in a reverse order. On the other hand, if the extraordinary size and character of fossil relics, in the high latitudes, are owing to a secular refrigeration of the earth, it will be interesting to know what were the types of animal and vegetable life, during the same geological periods, in the equatorial regions. If past periods in the tropics were as much more favorable than the present to the gigantic development of organic existences, as they certainly were in ours, the imagination can scarcely paint the monsters, which careful research may bring to light. I must confess, however, I saw nothing in the West Indies to countenance such suppositions. No animals or saurians, to my knowledge, contemporaneous with those imbedded in the secondary and tertiary formations of Europe and America, have yet been detected; nor, if we except the island of Trinidad, do I know of any indications of the existence of extensive subterranean deposits of vegetable matter. The pitch-lake of that island, and the petroleum which oozes from the rocks on the coast, are probably due to a vegetable origin; but if similar indications of carbon in a fossil state exist in other islands, they are yet to be discovered.

Most of the islands in the West Indies, as is well known, exhibit marks of volcanic action. Though not lying within the range of that great line of volcanoes which extends along the western coast of South America, and reaches to Mexico, they have often been subject to destructive earthquakes; and two of them, St. Vincent's and Guadaloupe, are at present the seats of active volcanoes. By inspecting a map of the West Indies, it will be seen, that St. Croix is near the northern termination of the crescent of islands, which, commencing with Trinidad on the south, and ending with St. Thomas on the north, constitutes the eastern boundary of the Caribbean Sea. These islands extend through more than eight degrees of latitude; and yet, it is impossible to look at their relative position, without suspecting that they were elevated by a common force, and have been subject to similar geological revolutions. This, so far as my own observation and the information otherwise obtained extend, I believe to be true. Many of the islands contain several formations, dissimilar in age and geological constitution; but they all bear, if I may use the expression, a striking family likeness. The prevailing formations in the West Indies are, in the first place, recent igneous rocks, comprising the products of active volcanoes and different varieties of trap; in the second, tertiary groups, consisting of marl, calcareous sandstone, and shell limestone; and in the third, a stratified deposit, which, without at present intending to intimate its place in the geological series of rocks, I shall call *indurated clay*. As I have already suggested, some of the islands present all these formations, indications of which are seen upon the first approach to them. St. Croix contains only the two latter, which divide the superficial area of the island about equally.

This island is in north lat. 17° 45′ 28″, and west long. 67° 12′ 40″. It is about 26 miles in length, and, on an average, not more than four or five in breadth. Its shape is irregular. The northern and southeastern parts comprise the clay formation, and the central and southern are calcareous. There is a striking contrast in the elevation of the two portions of the island. The clay formation is a pile of mountains, separated, however, by gorges and valleys, which run in every direction, and give to it a beautifully diversified aspect. The highest point is Mount Eagle, which is estimated to be about 1200 feet above the level of the sea. The calcareous formation is much lower and less broken, but undulating. The greatest elevation in this part of the island, is about 600 feet. It is that on which stands Bulow's Mindo, the elegant country-seat of the governor, so named in memory of his friend, Gen. Bulow.

The most striking feature of the mountains of the clay formation, is their high state of cultivation, even when they are so steep that they cannot be ascended except in mule paths, which wind up their sides in zigzag lines. All bear the marks of great violence in their elevation. The strata were much broken by the unequal application of the uplifting forces, and formed into many distinct and grotesque summits; some of which, however, have since been rounded by the hand of time. Nothing can exceed the beauty of these mountains and the intervening valleys, when covered by a luxuriant growth of the sugar-cane, interspersed with plantations and orange groves, and seen from a summit, which, at the same time, commands a view of several vistas to the ocean. Some of the mountains, however, are too precipitous for cultivation, and the rocks are too hard to be readily broken down into an arable soil. Such is most of the eastern section of the group on the north, and the extreme portion of the south-eastern range. In favorable seasons, the cultivated tracts yield good crops of cane, but they are peculiarly susceptible to the drought.

As a mass, this formation is distinctly stratified. The strata vary in thickness from six inches to three feet; and, in many places, are exceedingly regular and well defined. A good section of this description may be seen on the coast, below the Mount Washington estate. In others, they are schistose, and much contorted, as near Punch, in ascending from Little La Grange, and at a quarry contiguous to Jolly Hill garden. In some cases, no stratification is visible—the whole mass breaking up into small angular fragments, or being consolidated into columnar blocks, with a structure and cleavage resembling trap. Localities, however, of the last description, are not common; and the angular fragments of the other beds are generally soft and easily decomposed.

The strata are highly inclined. The lowest angle I observed was near Capt. Sempill's house, at Butler's Bay, which was about 45°. The inclination varies in different places, from this to 90°. It is generally from 70° to 80°. The direction of the dip is pretty uniform, and is nearly north. The composition and general aspect of the strata in different localities, and even in juxtaposition, are often various. In some cases, they are decidedly aluminous; in others, silex predominates. They also vary much in hardness, the more aluminous being generally soft and inclined to crumble, and the silicious requiring a smart blow of the hammer to break them. The grain is uniformly fine. I did not see, in this mass of rock, any thing like a pudding-stone. The formation seems to have been deposited in quiet waters, though there are frequent contortions in the strata, which may be due in part to the troubled state of the element from which they were deposited; but probably more to the force by which they were uplifted. There are beds in the ravine near Mount Victory, as we ascend on the road from Sprat Hall, which strongly resemble argillaceous slate. The color of the strata, in other places, passes through all the varieties of brown to that of clay. They are frequently colored red by the oxide of iron.

This is particularly true in the region of Annesley. In such cases, however, the oxide does not appear to have penetrated the substance of the rock, but to have been infiltrated through the seams and crevices. The soil is also impregnated with this substance.

Thin layers of quartz, from one fourth to half an inch in thickness, are often interstratified with this rock, and sometimes cut the regular strata, and also each other, diagonally. Mingled with schistose formations, I often found small beds of marl and calcareous spar. In some instances, the marl had been introduced from above, in the form of a deposit; in others, it was obviously interstratified with the rocks when they were formed. The streams, also, which ran down from the mountains over the hardest rocks, were more or less impregnated with lime.

I have already intimated, that the strata are often intersected by diagonal cleavage planes. This appeared to me a striking peculiarity of the formation. These planes were from one to three inches apart, sometimes parallel, but generally more or less inclined to each other. They were often crossed by others; so that the rocks naturally broke into angular, columnar, or rhomboidal fragments. It was often difficult to distinguish these cleavage planes from the true lines of stratification. In this respect, I was much struck with the similarity between these rocks and the greywacke formation of Wales, as described by Mr. Murchison.

The valleys and ravines of this formation, as I have already said, run in all directions, but more generally in that of the anticlinal lines of the strata. Such, for example, are those which extend from the coast road, at the west end of the island, towards Jolly Hill, Mount Victory, and New Caledonia.

Sometimes these valleys and the impending mountains are wild and picturesque in the extreme; in other cases, they are highly cultivated. The contrast is owing principally to the different degrees of hardness in the rocks.

One is at first surprised, that any portion of soil can be retained on the cultivated parts of the mountains, as they are so steep that, in ordinary cases, it would all be washed away. It would be in this, but for the fact, that the cane is planted in deep trenches, dug horizontally along the sides of the mountains, which prevent in a great measure the flowing of water; and also, that the rocks are continually decomposing and forming a new soil. Indeed this process of decomposition may every where be seen at present going on, in sections of roads cut through the rocks, where the passage from the solid, unchanged strata beneath, to the cultivated soil on the surface, is so gradual, that no distinct line of separation can be drawn.

A similar explanation is applicable to the different states in which the talus is found at the foot of the mountains. In some places, it is many feet deep, but thoroughly pulverized; in others, it remains in the state of broken fragments, covered with so little soil, as not to be susceptible of cultivation. This is strikingly seen at Ham's Bluff, which presents a stratum of undecomposed detritus twenty-five or thirty feet in depth.

The thickness of this formation is at least several hundred feet. On the west coast, north of Sprat Hall, the strata are seen standing side by side, in uninterrupted succession, for several rods; and, were it not for the gorges which break, occasionally, their continuity, the thickness might appear much greater.

As to its age, I am not prepared to express a decided opinion. On the one hand, it cannot be so low down as the older slates or the *metamorphic* rocks of Lyell; and, on the other, its composition, structure, and high inclination, bear a striking resemblance to those of greywacke. I did not observe it associated with older rocks, except in one place, near South Gate, where a bed of sienite occurs, thirty or forty rods in extent. As to organic remains, though I made diligent search, I found none; from which it must at least be inferred, that, if they exist at all, they are very uncommon. I ought, however, to mention, that, on the road from Little La Grange to Punch, I discovered in this formation, from two to three hundred feet above the level of the sea, a bed of limestone, in which were imbedded the leaves and trunks of dicotyledonous plants. They were both converted into the substance of the rock, but were well preserved. The largest specimens of wood I obtained were about four inches in diameter; though, if I am not mistaken, I saw the impressions of those much larger. The cortical layers were very distinct, and, through the smaller pieces, were holes, which the pith of the plant once obviously occupied. The bed which contains them is of limited extent. It was clearly raised with the formation in which it is implicated; and, if they are both contemporaneous, the clay formation is obviously of recent origin. I am in doubt, however, whether this bed is not the remnant of a calcareous stratum, which may have covered the whole of this formation when it was raised, but has since been removed by meteoric agents. If this supposition is true, other beds will probably be found, from which farther light may be obtained. I may also add, that just before leaving the island, I received some specimens of limestone, containing casts of corals and marine shells, taken from a bed, which was said to be found in this formation near Judith's Fancy. I would especially recommend this locality to the attention of any one who may hereafter have an opportunity to examine the geology of the island.

It may not be improper to remark, that this formation is exceedingly well developed at St. Thomas, an island about forty miles north, which bears a strong resemblance in its geological character to that part of Santa Cruz which I have just described. The columnar and trappean forms of the rock, imperceptibly graduating into regular schistose strata, are, perhaps, more common. This island, also, contains extensive localities of trap and porphyry. On the west side of the harbor, they are seen protruded among and overlying stratified and altered rocks, where the peculiar globular concretions of the trap are very apparent in the decomposing surfaces of large insulated masses. The clay and the trap are the only two formations of this island. Of the corresponding groups of Antigua, I intend to speak at another time. I will only add here, that indurated clay constitutes a district of considerable extent on the island of Barbadoes. I saw it near Codrington College, where it is not fully developed, and cannot therefore speak of it with confidence. Here it was more aluminous and less indurated than the rocks of which I have been speaking in St. Croix and St. Thomas. Indeed, at this place, the consolidated rocks were nearly covered by thick strata of clay mingled with sand, some of which were partially hardened into stone and dipped with the others at an angle of about ten degrees under the calcareous and tertiary formations, which constitute so striking and interesting a feature of that island. The greater portion of this district, consisting of strata highly inclined, is, I was informed, exceedingly wild, broken, and mountainous. Upon the whole, the entire class of rocks which I have been describing, though they may not be of precisely the same age, appear to me to have been formed in similar circumstances, and to owe their varieties principally to the different degrees of heat to which they have been subjected.

The general aspect of the calcareous part of the island, as I have before said, is undulating. With the exception of some estates on the south and southwest coasts, where the limestone rises to the surface of the ground, the soil is easily tilled and very fertile.

The strata incline at different angles and in different directions. Their prevailing position at the east end of the island, is a dip towards the west at an angle of about 10°. They crop out towards the east at Constitution Hill, and at King's Hill; but at an eminence near La Reine, towards the west, I saw them inclining in other directions, and, also, nearly horizontal, as at a quarry south of Mount Pleasant.

This formation presents considerable diversity also in composition. Perhaps it can best be described under three general divisions—the section which is now forming on the northwest coast—the marl and the calcareous sandstone, which occupy the central portion—and the limestone and coral crag, the former in most places overlying the latter, and together covering the south side of the island.

The first of these divisions is of limited extent. It is a narrow belt, from two to six rods wide, extending along the west, with few interruptions, from the bluff to Frederickstad. It consists of corals, shells, and comminuted detritus, thrown up by the waves upon the coast and agglutinated by a calcareous cement. Most of the shells are broken; the stronger ones, however, such as Strombus gigas, Turbo pica, Tellina remies, Arca Noe, are found entire, and even retain their natural colors. I observed a few more delicate shells of the genera Serpula, Lucina, Voluta, Bulla, &c.; all these species still inhabit the surrounding seas. In addition to this fact, there are other circumstances which show the recent origin of this deposit. This part of the coast is liable to a strong surf, which is constantly drifting shells and other substances upon the shore, and dashing over them spray charged with calcareous matter. These generally unite and harden, especially near the surface, and form into a tolerably compact mass. I also found imbedded in these rocks, iron utensils, which had been employed at no very remote period, in quarrying them. It contains many fragments and rounded pebbles of indurated clay, which as a general thing unfit it for the kiln.

Though it is obvious these rocks are still in the process of formation, they have been much abraded and broken by the surf. I doubted, indeed, for some time, whether they could have been formed in the face of such powerfully abrading agents; but the fact, that the windward coasts of coral islands are generally distinguished by the greatest accumulations of matter, removes the difficulty. I saw in one place a mass of rock containing about four hundred cubic feet, which had been detached from its bed, raised several feet, and thrown back upon the shore. This deposit every where rests upon the tilted strata of the indurated clay, which often form a precipitous bank, and generally rise within a short distance into high mountains. The shore is lined with tropical shrubs and trees, such as Hippomane mancinella, Guilandina bonducella, Coccoloba uvifera, Lantana involucrata, Turnara ulmifolia, Mimosa spinosa, &c.

The marl varies in composition, and hardens even within modrate distances. It often comprises extensive beds of lime nearly pure, and so soft that it may be dug with a hoe; in other places, it is mingled with sand, becomes harder, and forms a good building stone. In such cases, it is easily broken at first, but hardens by exposure to the atmosphere. In structure and general aspect I saw quarries much resembling those of the Paris basin, from which such ample materials for building are derived.

It is impossible to draw a dividing line between these beds and the purer lime deposits on the south and west. Both are no doubt contemporaneous, and owe their difference to peculiar circumstances in their deposition. The limestone sometimes occurs in a compact form; but the structure is generally loose and friable, especially at a little distance below the surface. It is often dug up for the purpose of deepening the soil, and left to decompose upon the surface. The lower beds, which rarely appear on the surface, are seen to good advantage along the southern coast, and consist principally of coral and shells converted into a ragged mass of nearly pure lime. The name *coral crag*, which I have applied to them, well describes their general appearance. The superficial beds, which are very imperfectly stratified, and have the appearance of a chemical deposit, vary in thickness on the coast from two to ten feet. The coral crag is not peculiar to St. Croix: I saw extensive beds of it in Barbadoes and Jamaica, where it often rises to the surface of the ground.

The whole calcareous group, which I have now described, obviously belongs to the tertiary formation. The first and most recent division may be classed with the formation of Guadaloupe, in which human skeletons have been found; and the others I am inclined to think do not extend back beyond the newer Pliocene of Lyell. I do not speak with entire confidence, because nearly all the shells which are found occur in the form of casts, from which it is often difficult to decipher the genera and species.*

Fossil coral, unaccompanied by marine shells, also occurs in many places; sometimes beautifully colored, and incrusted with calcareous depositions. Whatever may be the age of this formation, it is no doubt more recent than the indurated clay; for, in addition to other facts already suggested, we find imbedded in it great quantities of angular fragments and even large masses of rocks from that group. This circumstance may be explained on the supposition that the island has been elevated at two different periods; indications of which, if I mistake not, are found at several places, and especially at Jolly Hill, a distance of about a mile from the west coast, and near a hundred feet above its level. They consist of a calcareous deposit by the side of the road, near the mill, upon the uplifted strata of the indurated clay, resembling those which I have already described; and stratified banks of gravel contiguous to the garden, in which marine and lagoon shells are promiscuously imbedded. On the lower grounds between this and the sea, there are at present two lagoons, and also extensive beds of unstratified gravel, which have obviously been washed down from the mountains, and contain large quantities of shells belonging to the genera Helix, Caracolla, Bulimus, and Pupa, which are now extinct upon this island, but are found upon others in the neighborhood. I might adduce other evidence bearing on the same point, but the limits of this article will not allow.

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* The two best localities for shells are a quarry near Dr. Stedman's at the west end of the island, and one at the east end, from which building stone was obtained for the new prison.

The beds of the ocean are lined with coral on every side of the island, and, in many places, the reefs rise near the surface of the water. This is particularly true on the south coast, and at the harbor of Christianstad; which is, indeed, with the exception of a narrow break that affords a passage for vessels, completely enclosed by a coralline bank.

St. Croix contains but few minerals. Calcareous spar and arragonite are the only two varieties which I saw. The latter occurs in the form of small, parallel, combined columns, and of six-sided prisms with re-entering angles on the sides. Both kinds are well developed.

Though the soil of the island was originally very productive, it has been much impoverished by a long course of unvaried cultivation. The elements however of an admirable soil still remain; and all that is necessary is to bring them into a suitable combination. Many parts of the island might be exceedingly improved by an artificial admixture of the marl and clay; and all need a fresh supply of the nutritive principle of a vegetable compost. The island of Barbadoes, which much resembles St. Croix, both in the geological formations and in the worn state of the soil, has been wonderfully revived by improved agricultural processes, and especially by compost manures and a more frequent alternation of crops. I do not doubt that the productive powers of St. Croix might be doubled in a few years by similar methods; an object certainly deserving the attention of the landed proprietors.

## ART. IV.—*Geology of Antigua;* by Prof. S. HOVEY, late of Yale College, Ct., and Amherst College, Mass.

As I passed but two or three weeks at Antigua, and as these were principally devoted to a public object, I should not feel prepared to give even an outline of the geology of the island, without aid from foreign sources. This I fortunately have, in an interesting article, prepared by Dr. Thomas Nugent, and published in the fifth volume of the Transactions of the London Geological Society; and in another brief notice, written for the Antigua Almanac and Register by Dr. Thomas Nicholson. I had the happiness to become acquainted with both of these distinguished gentlemen, and to visit in company with them several of the most interesting localities of the island. Were the articles, to which I have referred, before the American public, I should not attempt to add any thing more; but as they are nearly or quite inaccessible to most of the readers of the Journal of Science, a brief sketch of the geology of the island, will not, I hope, be an unacceptable offering.

Perhaps there is no island in the West Indies, whose geology is so rich in variety and interest. It contains all the three formations, viz. indurated clay, recent calcareous deposits, and trap, which I mentioned in a preceding article as constituting the West India islands. They are all distinctly developed also within a territory of moderate extent, and yet are separated by broad lines of demarcation. But what constitutes the peculiar charm of the geology of Antigua, are the uncommonly beautiful and variegated silicious fossils with which it abounds. In this respect, I am not aware of the existence of any deposit in the world, which can be compared with it. I should confine my remarks to these extraordinary relics, were I not persuaded, that a knowledge of them must create a desire to learn something of their geological relations. For the purpose of best accomplishing the object which I have in view, I shall not follow a strictly geological arrangement in my observations, but having noticed the trap formation, I shall describe the two others in the order of their contiguity, and then give some account of the silicious minerals and fossils which are more or less common to all the formations.

Antigua is a little north of the centre of the circular segment of islands, which bound the West India Archipelago on the east. It is in north lat. 17°, and west long. 62°, and comprises an area of one hundred and eight square miles.

The trap formation commences on the southeast corner, and includes nearly one quarter of the island. The district is broken and mountainous, rising occasionally into summits of eight hundred or one thousand feet in height, some of which are bold and precipitous, and others more gentle and rounded, affording a luxuriant soil for cultivation. It is also divided by valleys, which intersect each other in different directions, and are beautifully mantled by a rich and ever-blooming vegetation. The rocks are considerably diversified. Basalt, in extremely distinct globular concretions, is not uncommon. Indeed, I saw concretions so perfect, that they might justly be compared to piles of cannon balls from three to six inches in diameter. In some instances, the interior was decomposed, and the concretions were presented in the form of well defined and regularly arranged cups imbedded in the surface of the rocks. Breccias and porphyry are very common. The latter is often of a comparatively light porous character; and, at a little distance, might easily be mistaken for red sandstone. The matrix has a red earthy appearance, and the imbedded feldspar and scoriæ are soft and easily decomposed. Drew's Hill is composed principally of a rock of this description. Breccias, of an exceedingly hard and compact character, are not unfrequent. I often saw them in the form of boulders, at considerable distances from their beds. Genuine greenstone, of a nearly homogeneous aspect, also occurs, and is sometimes employed for macadamizing the streets of St. John's. These rocks overlie, and are protruded among the stratified rocks of the contiguous formation in every possible manner. Not unfrequently one is enveloped in the other; and both are so blended and changed by having been suddenly brought in contact in opposite states of heat, that the line of separation can scarcely be perceived without examining their composition. At Drew's Hill, a vein of lamellar sulphate of barytes occurs in this formation; but of how great extent it is not easy to decide from the excavations which have yet been made.

This group is separated from the clay formation on the northeast, by what are called the Body Ponds, and by a small stream which issues from them and runs toward the northeast. The superficial area of this deposit is not great. It is an irregular belt, extending from Five Island Division and Dickinson's Bay on the northwest, through the island to English Harbor and Willoughby Bay on the southeast, and separating the calcareous formation on the northeast from the trap on the southwest. This district is much less mountainous than the one which I have just described. The greatest elevation is Monk's Hill, near English Harbor, which I should judge not to exceed five or six hundred feet. The whole formation is distinctly stratified, the strata inclining nearly north at an angle of 15° or 20°. They often crop out on the south in bold and prolonged escarpments; on the north the slopes are more gradual.

The mineralogical character of this formation, as well as that of the trap, varies exceedingly. As I have already remarked, the rocks contiguous to the trap have been much modified by heat, frequently losing not only their color but even their stratification. The most marked rock in the group is the one, which the traveller first strikes in leaving English Harbor on the road to St. John's. It constitutes Monk's Hill. It is of a green aspect; and, as it is broken up on the roads, very much resembles green earth. When minutely examined, it is found to consist of feldspar imbedded in green clay. In some places the clay greatly predominates, and gives the rock a homogeneous aspect; in others, not only feldspar but fragments of different minerals are cemented by the clayey basis, and the rock assumes the character of a conglomerate. Extensive beds are found in this formation, composed of yellow earth instead of green, and containing a foreign substance of a brown color. The coloring matter in both cases is probably iron or manganese. In the vicinity of St. John's, the rocks are more hard and silicious. Near Scot's Hill there is a quarry of a dull, homogeneous aspect, which much resembles a yellow free-stone. I also observed, about two miles southeast of St. John's, superficial strata of red sandstone imperfectly hardened, in which, however, clay much predominates over silex. Indeed, throughout this formation, clay, with few exceptions, is the prevailing constituent. Compared with corresponding formations of St. Croix and St. Thomas, these rocks contain much more feldspar—an ingredient, which, indeed, scarcely exists at all at those places; they have also more of the character of a conglomerate, but are much less inclined, and have been less subjected to heat.

The remaining formation is the calcareous. It is far the most extensive of the three, and comprises the north and northeast parts of the island. It is no where very elevated—the highest hills not rising more than 300 or 400 feet above the level of the ocean. The surface of the ground is generally undulating; sometimes the hills are abrupt and broken, having summits covered with a light soil and overgrown with tropical shrubs, particularly Lantana involucrata, Pisonia subcordata, and Croton balsamiferum. The slopes of the hills and the lower grounds are highly cultivated; and, in an agricultural point of view, constitute the best portion of the island. This formation is separated from the preceding by a low tract, extending from Dickinson's Bay to Willoughby Bay, which Dr. Nicholson thinks was, at no very remote period, submerged, and divided the island into two nearly equal parts.

The composition of this formation, like that of the corresponding one in St. Croix, is by no means uniform. In many places, it consists of marl, which may be easily quarried with a heavy hoe; in others, it is a tolerably compact limestone which can be broken only with a hammer. I did not observe any specimens of what I called "coral crag" in the geology of St. Croix, though further observation might have brought them to light. Dr. Nugent describes strata running through the marl, which I had not an opportunity to see, "consisting of a grit stone, divisible into thin layers," and appearing under a magnifying glass to be "made up of very minute fragments of quartz, hornblende, jasper, hornstone, and green earth, held together by an argillaceous cement." It also contains localities of a yellow calcareous sandstone, breaking with an earthy, conchoidal fracture, and employed extensively in architecture. As a group, this formation is stratified; but, in many places, the planes disappear, and the mass bears the aspect of a precipitate from water. Though it obviously rests upon the clay, the strata of the two formations are not conformable; those of the marl being sometimes horizontal, and at others inclined in different directions.

This formation contains a great variety of fossils. "Of these we may enumerate," says Dr. Nugent, "as most frequently presenting themselves, different species of madrepore, echinus, serpuda, pecten, cardium, strombus, cerithium, ostrea, trochus, cyprea, turritella, venus, lucina," &c. These are sometimes found entire, but they generally occur in the form of casts, either calcareous or silicious. Dr. Nugent also mentions several species of land and fluviatile shells, belonging principally to the genus Helix, which he has observed associated in the same locality with marine genera, as murex, arca, nerita, purpura, chama, trochus, &c. The most of these fossils have living exemplars in the surrounding seas. From the specimens which came in my way, (for I did not see a complete collection,) I think I should be safe in estimating the proportion of such as high as 70 per cent. If this estimate be taken as an approximation to the truth, the formation must belong to the latest tertiary or newer Pliocene period of Lyell. No relics of mammalia have yet been discovered in this group, nor indeed in any upon the island.*

As to the age of the clay formation, I have not sufficient data to form an opinion. With the exception of some petrified leaves found near its junction with trap at Drew's Hill, I could not ascertain that any organic remains had been discovered in it. These leaves belong to trees of the dicotyledonous class. Dr. Nicholson thinks he recognizes among them those of the Ficus pertusa, and a species of Melastoma. The mineralogical character of these rocks certainly does not indicate great age; still, neither this nor any thing in their relations to other rocks, points out their absolute place in the series of geological formations. We must wait, therefore, for farther light on this point, till their organic contents are better investigated.

Intimately connected with the clay formation, if not constituting a part of it, is another class of rocks of a most interesting character. I refer to the extensive beds of chert and the silicious petrifactions with which this part of the island abounds. Dr. Nugent describes these beds as a distinct deposit, lying above the clay and below the marl. His opinion is probably well founded; but they are so intimately associated with the clay formation, that I prefer to class them with that group. Their comparative extent is not great. They are found principally in the neighborhood of St. John's and of Constitution hill. Near St. John's they have been disturbed by uplifting forces, and constitute two or three summits of moderate elevation, on one of which stands the cathedral.

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* Of the age of the corresponding formation in Barbadoes I can speak with greater certainty. Of forty one species of conchifera and mollusca, which I obtained during ten days' residence upon the island, there were only three which are not found at present in a living state in the West Indies.

At this place, the chert is strangely intermingled with limestone, and it is not very obvious which occupies the lowest position. At an eminence a little south of this, it is broken up into immense masses, which appear like outliers or ledges on the sides of the hill. In the region of Constitution hill, and farther south on the road to English Harbor, it appears in the form of square and angular blocks, from a few inches to two feet in diameter, strewed in great quantities over the surface of the country. I saw only one or two beds which had not been disturbed. They were distinctly stratified, and lay in a position, so far as I could judge, conformable with the strata of the clay formation. I saw no place, however, where one distinctly graduated into the other, or where they came directly in contact.

The aspect of this rock is various; generally, however, highly vitreous. It sometimes approaches to jasper, both in constitution and color; at others it is a pale hornstone; and it is often seen of a still coarser structure. The fracture is sometimes even, often conchoidal, and not unfrequently splintery. The structure of the masses of which I spoke on the eminence south of the church, differs from any which I saw elsewhere. It was more porous, giving to the rocks an appearance not unlike a silicious tufa, which had been impregnated with iron and hardened by heat. This family of rocks is altogether of an interesting character, entirely unlike any thing which I have seen in other parts of the West Indies or of the world. Their geological interest is greatly increased by the immense quantities of shells which they contain, supposed by Dr. Nicholson to be Melaniæ.* These shells are always silicified; sometimes standing out from the rock in beautiful relief; at others entirely imbedded, and, with the exception of the coloring matter, converted into its substance. I saw specimens of this description most elegantly polished. According to the best information which I could obtain, these shells are found only in rocks of the chert family, which is a very important circumstance in ascertaining the origin of the beds.

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* Dr. Nugent calls these shells cerithium. I am not satisfied that either of the above names is correct; nor have I been able to consult any conchologist in regard to them, on whose opinion I can rely.

As I have already intimated, the two preceding formations abound in the silicious fossils of an exceedingly interesting and important character. For variety of structure, for fineness and beauty of material, and for richness of color, I know of none in any part of the world in comparison with which they would suffer. They are found in the form of jasper, cornelian, agate, chalcedony—sometimes existing separately, at others all beautifully blended in the same specimen. The coloring matter also varies in intensity, presenting every tint and shade which are peculiar to those minerals. But the most striking feature of all, is the perfect preservation of the form and structure of the petrified substances, even of such as in a living state are most delicate. For example, the opening leaves of the banana, than which no vegetable fibre can be more tender, have been converted into silex and perfectly preserved. I saw myself the petrified pod of a tamarind, so entire in its shape and all its parts, that no one could mistake it.

These fossils may conveniently be divided into two classes—the *marine* and the *land* fossils. The former consist of corals, shells, &c., which are found principally in the calcareous formation, and are particularly abundant and beautiful in Belfast Division. They frequently appear on the surface, but are often found at considerable depths. The corals are frequently very striking; they are converted into chalcedony both pure and colored, but still retaining their pattern so perfectly, that the genus may be recognized when they are set in a breastpin. All the fossils in the calcareous formation are by no means of this character. Many of them are calcareous. The silicious prevail only in particular districts.

But the most interesting class of fossils is the silicified wood—the ordinary trees and shrubs of the climate still retaining their individual structures, but converted into the choicest mineral substances. Fossils of this class are confined to the chert and clay formations. They are generally found intermingled with the chert in broken fragments, and scattered over the surface of the earth. Sometimes in low districts, they constitute immense beds, and give one the idea of a thick forest, which has been prostrated by some mighty tempest, converted into silex, and buried beneath the ground. The fragments are not usually more than ten or twelve inches long, and are frequently split in the direction of the fibres. The most perfect specimen which has been found, is described by Dr. Nugent, as being the "trunk of a tree about twelve feet in length and as many inches in diameter, rent crosswise asunder, but all the parts lying contiguous to one another." The largest section which I saw, was eighteen or twenty inches in diameter, and about two feet in length.

Though these fossils are all silicious, they vary exceedingly in the perfection of the material and in the beauty of their colors. Sometimes they present a dull, compact, earthy aspect—sometimes the grain is coarse and the fibres are indistinct; but when a combination of fine grain, variety and beauty of colors, and distinctness of structure, is found, the specimens are exceedingly elegant. Among these may be particularly specified, dendritic and moss agates, and the petrifactions of the loblolly (Pisonia subcordata.) The cocoanut, also, is often very beautiful, especially its involved fibrous roots. A person who has seen the tree in its natural state, would instantly recognize its petrifactions. The same may be said of many other specimens. Indeed, they are generally as distinct from each other, as the living fibre of one tree is from that of another. The most of these fossils, I do not doubt, are relics of shrubs and trees identical with those now growing upon the island, though some of them are probably extinct. In addition to these petrifactions, specimens of jasper, either pure or mingled with chalcedony, are abundant. They often occur in veins of trap, and abound most in the neighborhood of that formation. Fortification agates are also found in the form of nodules, both upon and below the surface of the earth.

The preceding details open to the geologist a most interesting field of speculation. The extent to which silex, in its purest and most interesting forms, here presents itself, is, I believe, within the same compass of country, without a parallel. It has converted into its own substance organized bodies of the most opposite characters, and in every variety of circumstances. It presents them under all forms and of every degree of color and perfection. It reminds one of Midas's touch, which changed every thing into gold. It will hardly be expected that phenomena, so varied and complicated, can be referred to a common origin. Indeed it is obvious, from the partial examinations already made, that they are due, not to a single cause, but to a combination or rather a diversity of causes. For example, some of the finest specimens of jasper are found in trap veins, and in the neighborhood of trap rocks. There can be no doubt, therefore, that these are to be ascribed to igneous agency, converting an aqueous rock into this beautiful substance. Lyell, De La Bèche, and other authors, have detailed similar facts occurring in other parts of the world. But in regard to the chert deposits, and the immense quantities of petrified wood connected with them, I think we must look for the agency of some other cause. The circumstance that those beds contain shells, either marine or fresh water, or both, is indubitable evidence, that they are an aqueous deposit. But whether they were originally deposited in their present form, or whether they are altered rocks, is a question about which there may perhaps be some difference of opinion. It is perfectly obvious, that since their formation, they have been subjected to the action of an internal force, which has thrown them up and broken them in pieces, and perhaps in some degree changed their constitution. The island, also, in the trap formation and in the contiguous altered rocks, affords the most ample evidence of comparatively recent igneous action on a broad scale. The position of the strata, also, being conformable with those of the clay formation and not separated by any definite lines, might be considered as favoring the supposition, that they both belonged originally to the same class of rocks. Though I know of no example on so large a scale, where rocks of this description can clearly be traced to such an origin, yet cases of a more moderate extent are not unfrequent. And if we admit, with Lyell, that all the earlier slates are merely metamorphic rocks, changed from sandstone and other fragmentary deposits into their present semi-crystalline forms by internal heat, we seem to have an acknowledged cause adequate to the effect. But, however sublime and interesting such a conception may be, we are not perhaps yet prepared to admit it among the sober truths of geology. But independently of this objection, there are peculiar circumstances, which seem to refer the beds in question to another origin. I have already remarked that the shells imbedded in them show, that they were originally deposited from water; and the fact that these shells are peculiar to the chert—that is, are not found in strata of the clay formation—seems to be conclusive evidence, that the two classes of rocks were formed under different circumstances. All the chert beds do not, indeed, contain shells; but as they are not found in *any* of the strata of the other formation, they seem to indicate a palpable line of distinction between the two.

If then we refer the chert and the petrifactions connected with it to a silicious solution, we may still inquire from what source such a solution could have been derived. It is well known, that pure silicious deposits from hot springs are not uncommon, and that such springs abound in volcanic countries. The Geysers of Iceland are striking examples of this kind. And though Antigua is not at present a volcanic island, it presents the most manifest exhibitions of igneous agency at no very remote period. These silicious deposits and immense fossil transformations may have taken place at that time, either from subaqueous springs charged with silex, or large bodies of water thrown up from the bowels of the earth, and spread out on the surface in the form of basins. The low position of the part of the island where these beds abound, would perhaps favor this supposition. I am, indeed, aware that the subject of silicious solutions is yet involved in great mystery—the process by which nature dissolves silica having yet in a great measure evaded the scrutinizing eye of science—but the fact is among the best ascertained phenomena of geology, and may therefore be employed in the explanation of those deposits, which other circumstances would naturally refer to such an origin.

I cannot but regard the fact, that minute fibres of the roots of trees, and tender leaves and fruits, which must certainly have been destroyed by the least degree of violence, are found among the fossils, as furnishing additional evidence, that the lapidifying process took place in a silicious solution. It does not appear possible, that any great degree of heat should have existed in the superficial strata of the earth, without having destroyed every thing on the surface in the form of woody fibre.

But there is another class of silicious fossils, found in the calcareous formation, at a distance of several miles from the chert deposits, which cannot be explained upon any of the preceding hypotheses. They are the silicified shells and corallines, which I have already described as occurring both upon the surface of the earth and in lower strata. The corallines, especially, are so perfectly agatized, that they are cut by lapidaries for jewelry and other ornamental purposes. In addition to these, nodules of chert are found in the clay formation; detached from the beds of chert; and also agate nodules, of which I have before spoken. I do not see how either of these classes of fossils and minerals can be referred to silicious springs; for there is no evidence that such springs have existed where they are found, or that they could, under any circumstances, have been produced by them. I am aware, that Lyell and some other geologists have ascribed analogous phenomena to heated vapors and aqueous solutions charged with silex, and forced up through the superficial strata from the interior of the earth. To say nothing of the adequacy or inadequacy of such a cause to produce the phenomena in question, I think a person who has well considered the concretions with which many clay beds abound—the nodules of flint in chalk—the segregation of mineral matter from the mass with which it must have been originally blended, and its aggregation into distinct crystalline forms—and, also, the contents of metalliferous veins and fossil fissures of rocks; must have recognized an agency better adapted to the present case, than any sublimation from the interior of the earth. Mr. Bird's suggestion, at the last meeting of the British Association for the Advancement of Science, that wood is silicified by electrical influence, is certainly countenanced by many facts; and it is to be hoped, that the experiments which he has commenced on the subject, together with those on the formation of minerals, will do something towards defining another boundary of the immense but mysterious domain of electrical agency. It is possible that all the petrifactions of which I have spoken in Antigua, may at length be referred to this source. I see nothing in their character or circumstances which forbids such a supposition; but, in the present state of our knowledge, I think the explanation which I have given is the most probable. I am aware, however, that these fossils and the whole geology of the island need a much more minute examination than they have yet received, in order to draw any theoretical conclusions, in which entire confidence can be placed. I know of no field which would more amply repay the geologist for such an examination; and should the imperfect sketch which I have given, have no other effect than to direct the attention of some one to this island, I shall not consider myself to have labored in vain.

## Art. V.—*Remarks on the Geology and Topography of Western New York;* by George E. Hayes, of Buffalo.

In a former paper, inserted in this Journal,[*] I endeavored to show, that the rock formations in the western part of this state belong to the transition series.[†] I now propose to offer some observations on the causes which produced the disintegration and removal of extensive strata of these rocks from their ancient beds of deposit, and gave rise to the existing topographical phenomena.

The "saliferous rock" of Prof. Eaton, which I there designated as the old red sandstone, forms the southern shore of Lake Ontario. It has an average breadth of about six miles, nearly a level surface, and is little elevated above the lake. Its southern boundary is marked by the great limestone terrace, under which it passes.

Overlying this old red sandstone, is a group of calcareous rocks—the "geodiferous" and "cornitiferous" of Prof. Eaton—with their accompanying shales; which are evidently equivalent to the mountain limestone of Europe. This formation terminates on the north, in a line nearly parallel to the lake shore, by an abrupt precipice, which forms what is here called the "mountain ridge." The limestone district forms a kind of terrace, bounded on the north by this precipitous escarpment, and on the south by the mountainous region which occupies the south tier of counties.

Superimposed on the mountain limestone, we have a series of shales and slaty sandstones of great aggregate thickness, dipping, as do the formations already noticed, in a southerly direction, but less able to resist the powerful, degrading action to which all have evidently been exposed. The deep valleys, which penetrate this formation in a southerly direction from the great limestone terrace; the dividing ridges, also, which have their northern terminations on the same terrace, becoming more rugged and mountainous as they approach the Pennsylvania state line, with their sides deeply furrowed by precipitous gullies and ravines, are sufficient proofs that other causes of denudation than the insignificant streams which traverse these valleys, have been in operation.

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[*] Vol. xxxi. p. 241.

[†] As early as 1824, Dr. Bigsby suggested that the horizontal limestone of Western New York, as well as that of the Canadas, was "the representative of the mountain or Carboniferous limestone of England." See American Journal, Vol. viii. p. 76 and onward.

Again, in 1829, Prof. Vanuxem stated his conviction that they were transition rocks. Ibid. Vol. xvi. p. 254.

In Bakewell's Geology, second American edition, p. 369, the same opinion is repeated: notwithstanding which, from the confusion produced by the introduction of new names, and an apparent disposition to adhere to the classification of Prof. Eaton, they have till very recently been generally regarded as belonging to the secondary class.

One peculiar feature, which adds greatly to the picturesque scenery of Western New-York, arises from the fact that many of these valleys have been excavated to a level below the general escarpment of the limestone terrace,* which consequently forms a barrier at their mouths, and gives rise to most of those beautiful sheets of water so justly admired by the lovers of fine scenery. This feature will again be alluded to further on.

The aggregate thickness of the rock strata, from Lake Ontario to the northern outcrop of the coal in Pennsylvania, is estimated by Mr. James Hall at six thousand and fifty one feet.† How far they extended to the north, and whether the primitive regions on either or both sides of the St. Lawrence, were originally overlaid by them, are questions difficult to solve, and which require the minute and careful examination of the geologist. There are some circumstances, however, which seem to favor this conclusion. It is stated by Dr. Bigsby,‡ when speaking of the horizontal limestone of the Canadas, that "this limestone forms a horizontal girdle around the trap mountain of Montreal, from which, as from a centre, large veins or dykes radiate into the adjoining limestone to the distance of two miles in some cases to my own knowledge, and even to La Chine, according to information received from M. Burnett, chief engineer to the La Chine Canal. The limestone in its upper strata, is brown and crystalline, but black, compact, and slaty below. It contains in immense quantities the organic remains peculiar to the mountain limestone of England and Ireland." It is also stated by Prof. Vanuxem,§

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* Since writing the above, my attention has been called to the fact that Mr. David Thomas communicated this phenomenon to Prof. Eaton in 1830. See American Journal, Vol. XVIII. p. 376.

† New York Geological Report, 1838. See Atlas.

‡ American Journal, Vol. VIII. p. 71.

§ New York Geological Report, 1838, p. 255.

that extensive uplifts have been produced on the northern slope of the valley of the Mohawk, "which have deranged the surface, and destroyed the continuity of strata and rock; and created to the casual observer, where the uplift exists, the greatest apparent confusion as to their superposition or order of arrangement." This being the case on the flank of this primitive range, where the sedimentary rocks come in contact with it, is conclusive evidence that they were deposited before the uplifts took place, and may therefore have been spread out, and occupied the whole district.

Whether this were so or not, there can be no doubt that the rock strata in the western part of New York, have been disintegrated and removed, from extensive tracts north of their present limits. It would be absurd to suppose they were deposited in such ridges, with steep escarpments, as we now find them. Nature does her work less artificially. The outcropping edges of these strata; the waterworn and somewhat polished surface of the limestone rocks; the deep valleys which penetrate the shale; and the precipitous escarpments of the more enduring strata, bear the unequivocal impress of secondary causes. All must admit, that the present surface has been shaped by the process of removal, long since that of deposition was completed.

That these rocks were deposited at the bottom of an ocean, is evinced by their fossil contents; that they have been elevated from its watery bed, requires no additional evidence other than their present altitude above its permanent level. If we seek for the cause of this gigantic phenomenon, and trace the ascending strata in a direction opposite to their dip, we invariably come to primitive rocks, or other proofs, equally unequivocal, of volcanic agency.

If, then, as is now very generally admitted, these primitive districts were the original centres of elevation; if the process was gradual and continued for an indefinite period; or was intermittent, being active at one point while dormant at others; these vast changes, as well as those of a like character in other parts of the world, may be explained on rational principles. We need no longer be driven to the poor necessity of supposing a train of causes which may never have existed, and which if admitted to have operated, would probably have produced results far different from those usually attributed to them. Why not then lay aside the fashion of attempting to explain such phenomena by invoking the assistance of the Noachian Deluge, or of tremendous inundations, sweeping over the tops of the highest mountains, produced "by the flux and reflux of mighty deluges, caused by the sudden elevation of mountain chains in various parts of the globe?"* Sound philosophy forbids these violent presumptions, particularly when the facts admit of explanations more consonant with the natural order of events.

The condition of a continent, gradually elevated from the ocean, whether by volcanic action, or by the expansive force of crystallization, or by any other cause whatever, would be such as to account for all the geological phenomena hitherto attributed to the mechanical action of water. Every portion of a continent thus reclaimed, must, in succession, have been the bed, and then the beach of an ocean. Every portion must have been subjected to the action of the waves and the tides, when lashed into fury by the raging storm; and for a period of time only limited by the greater or less rapidity of the elevatory process.

When any considerable portion had become permanently elevated above tide water, it would form a water shed, collecting the rain into rivulets, which, finding their way to the ocean, would cut out narrow channels for their beds. But the effect of these streams in the formation of valleys, by denuding and tearing up the rocky strata, would be insignificant in comparison with the action of the surge at those points where their waters were disembogued. As each portion of such channels would successively be exposed to their combined action, and must successively form the bed of an estuary at the valley's mouth, we can readily account for their excavation, to a greater or less extent, in proportion to the hardness of the rocky bed, to the violence of the waves and tides, and the duration of their action. In these estuaries, the comminuted materials would assume nearly a horizontal position, and when left dry, would resemble the alluvial plains or "bottoms," which border most of our rivers. Should a sudden rise of a few feet take place, the water would at first recede; but by the action of the waves and tides on this alluvial mud, they would soon regain possession of that part of their former bed, bordering the stream to a greater or less extent. The centre of the valley would thereby be lowered; and this process being repeated, a series of terraces, or steps, would result, precisely similar to those in the valley of the Connecticut river, which Prof. Hitchcock attributes to the fluviatile action of existing streams.* Valleys could thus be formed where streams of no great magnitude ever flowed, and where currents, except the ordinary ones of the ocean, never existed.

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* Nearly every geological writer, excepting Lyell, whose works have fallen under my observation, even without including those who have evidently been influenced more by theological than scientific views, has drawn largely on these wonderful deluges; and the means by which they are supposed to have been produced, are equally fanciful with the presumption itself. The passage from which the above quotation is taken, (see Hitchcock's Geology of Mass., p. 242,) is perhaps not a very extravagant specimen of this kind of hypothetical reasoning. See also p. 218.

The formation of sand banks and of gravel beds, the rounding and transportation of boulders, the formation and distribution of what we call diluvium, all admit the same simple explanation. Truth is said to be more wonderful than fiction; however this may be, it usually proves more simple than hypothesis. We ought not, therefore, to be surprised, if the phenomena which have led to the crude notion of a deluge, or a succession of deluges, have been produced by an agent no less active now than at any former time; an agent, as much more powerful in its action, as it is permanent in its duration.

Could the Atlantic be drained of its waters, we should find great diversity of surface; and that portion occupied by the Gulf stream, would unquestionably present a succession of beds of sand, gravel, clay, &c., with boulders, more or less profusely distributed, in proportion to their proximity to beds of rock, or cliffs, which have been successively undermined by the continued action of the surge. In other words, we should find the surface covered with diluvium, and arranged, perhaps, very much after the fashion of that in Massachusetts, described by Prof. Hitchcock, as exhibiting "concavities and convexities resembling very much the sandy or gravelly bottom of existing streams, where the current has been very rapid."†

Assuming, then, that the transition rocks of western New York extended far to the north, probably or possibly covering that portion of this State, and of Canada, which now constitute the primitive districts, and which seem to have been the nearest points of disturbance, it must follow as a consequence, that they were the first brought into contact with the waves by the process of elevation. As few points could then have been permanently raised above the ocean, east of the Rocky Mountains, the action of the surge was unbroken; and it is highly probable, that for a considerable time, the two processes of elevation and disintegration, made equal progress. When, however, the primitive nucleus was laid bare, and Mount Marcy had attained an elevation above the level of the ocean, and bid defiance to its waves and the thunders of its storms, then, and not till then, New York obtained her first "foothold on terra firma." This "war of the elements," however, must have been of long continuance before any portion of the sedimentary rocks were rescued from the dominion of the ocean. Mount Marcy has an elevation of 5467 feet;* while Roundtop, of the Catskill, composed of sedimentary rocks, is but 3804 feet;† and from the best data in my possession,‡ the highest peaks of the dividing ridge which separates the streams flowing south from those which take a northern course to the St. Lawrence, do not probably exceed 2000 feet above tide water. The elevation of this part of the continent, therefore, must have been exceedingly gradual, to give time for the degradation and removal of such an immense amount of matter; and it would seem probable, that it was not till the shoals had become so extensive as to obstruct the further action of the waves and arrest the removal of the detrital matter, that this ridge attained a permanent elevation above tide water.

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* Geology of Massachusetts, p. 134.

† Ib. p. 144.

Whether it prove true or not, that these rocks have been removed to so great an extent as the foregoing train of reasoning presupposes, is of little consequence to the main question under consideration. The broadest ground has been assumed, in order to show that the causes assigned for the topographical phenomena of this part of the state, are abundantly sufficient, not only to account for what we actually witness, but also for any extent of change which facts may hereafter demonstrate.

Supposing even, that no very great extent of strata have been removed, that these ancient deposits thinned out rapidly on the north, and that the surface has only received such modifications as are every where apparent, from the remaining strata; is there any power in nature with which we are acquainted, other than the one suggested, capable of effecting the change with so much regularity and order? Every inch of surface has been subjected to the denuding agent; the tops of the highest hills, no less than the limestone platform, bear the scars and scratches of the contending elements. The surface, except on the steep escarpments, is every where covered with a thick coat of diluvium; composed of water-worn pebbles, boulders, sand, &c. The valleys are often deeply filled with these materials, more or less comminuted; and sometimes they contain large quantities of detrital matter, little worn, evidently derived from strata similar to those of the adjoining hills.

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* Prof. Emmons, New York Geological Report, 1838, p. 244.

† Prof. Emmons, New York Geological Report, 1837, p. 100.

‡ See Am. Journal of Science, Vol. xxxiii. p. 122.

The condition of an ancient inland lake* which has burst its barriers and disappeared, could not account for these things; nor could its drainage from a higher to a lower plain, as suggested by Prof. Rogers,† excavate the deep and long ravine through which the Niagara now flows. It is equally idle to suppose, that the existing streams have excavated the valleys through which they flow; much less could they have effected the comminution and uniform distribution of the coat of diluvium. And as for a sudden inundation, deluge, or any succession of them, (aside from the improbability of nature stepping so far out of her ordinary track,) had they been sufficiently powerful to tear up the strata, and lay bare so large a district of the limestone rocks, we should hardly expect to find the work so systematically accomplished. A great deluge, it is true, may account for the uncovering of the limestone; and by sweeping heavy boulders over its surface, might have produced the "diluvial scratches." But portions of this rock are highly polished, and indicate a much longer continuance of the watery friction than is consistent with the notion of a deluge. The systematic and parallel arrangement of the long sloping ridges, composed of shale and sandstone, no better adapted to resist a sudden and overwhelming inundation than those portions which have been removed from the intermediate valleys, could hardly have resulted from any sudden irruption of water. The strata would have been indiscriminately torn up; and the ruins, instead of being finely pulverized, and beautifully distributed over the surface, to hide the "nakedness of the land," and prepare it for cultivation, would have been thrown together by the eddies of the currents into unsightly heaps; and this fair region, instead of being the "garden of the West," would have presented to view the uncouth surface of barren rocks, and would have offered, comparatively, few inducements for the laborious enterprise of the agriculturist.

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* The numerous proofs that this whole region was once submerged, early led to the theory of an ancient lake, far more extensive than any or all of the existing ones put together. Had the pass through the Highlands been closed up, and a barrier of sufficient height existed across the valley of the St. Lawrence, such a lake must have been the result. But these have not been rendered probable by any indications hitherto discovered; and there is no reason for presuming that they ever existed.

† See American Journal, Vol. XXVII. p. 329.

But to return.—Suppose this dividing ridge to have attained an elevation above tide water. The southern slope would present to the waves the smooth surface of the strata; whereas their basseting edges would be exposed on the northern declivity. Deep notches would soon be worn into it from both sides, which would occasionally interlock, and sometimes meet; thereby cutting the ridge into a series of islands, with transverse passes between them. These islands now form the highest peaks of the range; and the passes correspond to the elevated valleys, in which the principal streams take their rise.

When a considerable elevation had been attained, small streamlets would collect; and at the places where they entered the sea, the waves and the tides would be more powerful in tearing up and removing the shaly rocks, than at any other points; and thereby a system of valleys of denudation, precisely similar to those we here witness, would be commenced. On the southern slope, where the streams flowed over the inclined planes of the strata, in the direction of their dip, they would meet few obstructions, and lakes would seldom be formed. Not so on the northern declivity. There, where the streams flowed over the edges of the strata in an opposite direction, each harder layer, being longer able to resist the denuding process, would, for a certain distance, form the bed of the stream; and the dip, being in the direction opposite to the current, a succession of pools of slack water would result. These phenomena may frequently be illustrated by the small streams on the northern slope of a hill, where some of the strata are composed of hard, close-grained graywacke; while those on the southern declivity of the same hill, present an opposite result.

The same thing occurs in many of the valleys, but on a vastly larger scale; the shale and sandstone being cut through and removed down to the surface of the mountain limestone, as before stated. In cases like this, the latter rock, at its northern outcrop, forms a barrier across the mouths of such valleys. The streams which flow into them, are obstructed at these points; and lakes of greater or less magnitude result. All of those whose outlets are situated on the line of bearing of the limestone strata, which extends from the Niagara to the Hudson rivers,* as Canandaigua, Seneca, Cayuga, Skaneateles, and some of the smaller lakes, doubtless owe their origin to this peculiar feature in the dip and arrangement of the strata. Other valleys, also, in this range, were probably once occupied by lakes. In that of Bristol, the depth of the alluvium is unknown. In sinking wells, trunks of trees are met with at considerable depths; and in one instance, a frog is said to have been dug up, which, on being exposed to the vivifying influence of the sun, took advantage of his newly acquired freedom, and hopped off, with much apparent satisfaction.

Lake Erie is somewhat similarly situated, in as much as the floor of its basin, and the barrier at its outlet, are formed by the mountain limestone. But, instead of lying at right angles to the bearing of the strata, it occupies a basin at the junction of the shale and limestone, formed by the removal of the outcropping edges of the former. Its longitudinal direction, therefore, has a general coincidence with the line of bearing of the strata; and its northwestern shore, consequently, is formed by the mountain limestone, which, in that direction, attains an elevation above the surface of the lake, and underlies the peninsula in Upper Canada, included between Lakes Erie, Ontario, Simcoe and Huron.†

Before this limestone terrace had become sufficiently elevated to shut out the sea from the basins now occupied by these lakes, their shores were swept by its waves, and they differed in no material features, from the estuaries of rivers, or the bays which indent our sea coasts at the present day. It is highly probable, also, that a strong current set in through the Gulf of St. Lawrence, and found its exit through the valleys of the Mohawk and

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* Prof. Vanuxem, New York Geological Report, 1838, p. 272.

† Dr. Bigsby, American Journal, Vol. VIII. p. 78.

Hudson; forming for itself a channel through the Highlands, if that pass did not previously exist.

The large quantity of primitive boulders scattered over the surface, and distributed promiscuously through the diluvium, would seem to indicate some such movement. That they came from the north, has often been suggested; and the fact, that the nearest primitive rocks, in place, occur in that direction, renders the assumption highly probable. I have noticed one within the boundaries of this city, containing the Labradorite. It is doubtless identical with the Hypersthene rock in Essex county,* or with a similar rock described by Dr. Bigsby, as occurring on the northeast coast of Lake Huron,† and probably came from one of those locations. That loose masses of rock have been frozen into cakes of ice, and widely distributed over the surface of the earth, seems to admit of no doubt, as the same phenomenon may be witnessed in all currents of the ocean which flow from high latitudes towards the equator.

But by whatever agent these boulders have been transported, whether by the buoyancy of congealed water, and dropped in a more southern latitude, when disencumbered of their icy bark, or, swept along by the unaided force of currents, tides and waves, they have left their "marks" engraven on the surface of the limestone rocks, in characters which bid fair to prove indelible, and by which we may obtain a clew to their early history.

The Niagara river takes a course at right angles to the general direction of Lake Erie, and, in its descent to Lake Ontario, cuts directly across the limestone terrace, which, at this point, exceeds thirty miles in breadth. The upper strata of this lime-rock, contain layers and strings of chert, which form a kind of net-work, and render them almost incapable of disintegration from ordinary causes. These strata form both the barrier at the outlet of Lake Erie, and the rapids, between Buffalo and Black Rock. Below the northern outcrop of these cherty layers, which may be regarded as forming a kind of step on the terrace, and upon those strata which terminate at the mountain ridge, lie the shallow valleys of the Tonnewanda and Chippewa creeks, one of which flows to the west, and the other to the east; both entering the Niagara between Black Rock and the Falls.

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* See New York Geological Reports, 1837 and 1838.

† American Journal of Science, Vol. VIII. p. 69.

The northern boundary of the terrace, as before stated, terminates by an abrupt precipice, rendered more rugged and forbidding in appearance, by the disintegration of the shale on which it rests; causing the harder strata to project from the bank, and when sufficiently undermined, to be precipitated to the plain below. This action goes on, till the talus covers the face of the shaly strata, and protects them from further disintegration. The mural precipice above might apparently remain for ages, without suffering material change. This escarpment is indented by numerous ravines which penetrate the bank to a greater or less distance. The streams which now occupy these indents, are mostly insignificant in size; while many, some of which extend farthest back from the general line, drain but a few hundred acres, and are only occupied by the water which oozes from their banks, except during heavy rains, and the thawing of the snow at the end of winter. When viewing this escarpment, it is difficult to resist the conclusion, that the terrace once extended much farther north, and has been undermined and broken down by the action of the surge.

Not unfrequently, persons who visit the falls of Niagara, and superficially examine the topography of the surrounding region, conclude, that the cataract was once located at Lewiston, seven miles below its present location. Full of this grand conception, and without taking into the account the causes which gave rise to these general topographical features, they first attempt to ascertain its perpendicular height at that time. Having settled this to their satisfaction, they often launch forth into a train of calculations, alike unprofitable and extravagant; first to determine their age, and then, the number of years they will occupy, in their backward course, before they will invade the rocky ramparts of Lake Erie.* But, as in the onset, the origin of the cataract, one of the most important terms of the problem, is entirely omitted, their conclusions are wholly erroneous, and are entitled to as little consideration, as the "baseless fabric of a dream."

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* After all, perhaps those geologists who only view the falls in theory, are the most prolific in drawing such conclusions. A series of lakes, situated like this chain through the centre of North America, with rocky beds which shelve gently from the shore, might perhaps be drained in the course of ages, by the gradual wearing down of their outlets; but never so rapidly as to produce inundations, such as are assumed to have happened, at one time or other, over most parts of the earth; and which this hypothetical deluge, which is to inundate the fair valley of the St. Lawrence, some 30,000 years hence, is cited to illustrate.

In order to understand the origin, and to account rationally for the present location of this cataract, let us go back to the time when the process of elevation was going on, and the highest parts of this limestone ridge had just appeared above the surface at low water. It then became a partial barrier across the ancient gulf, and cut-off the free communication between its southwestern extremity (now Lake Erie) and the northeastern section. Across the lowest points of the reef, a strong current would be thereby produced, alternately flowing in opposite directions, during the ebb and flow of the tide. As the reef became more elevated, the currents would gradually become more and more confined to those passes where the fewest obstructions existed. In process of time, some one of these gaining the ascendency, the whole force of the conflicting currents would be concentrated at one point. The power of the waves and influx of the tide, operating from below, would be applied to the best possible advantage, in tearing up those strata which most impeded their course; while the cur.ent, combined with the receding tide, would carry off the fragments. In this manner the valley of the Niagara was doubtless formed; and circumstances, which will be detailed further on, render it highly probable, that the ledges above the cataract, which form the rapids, had the same origin.

That such a strait did exist, after Lake Erie became fresh, and before the deep gorge below the falls was excavated, is certain. The ancient banks may be traced on both sides of the gorge; and that portion of the ancient bed, from the brink of the precipice up to the level of the river above the rapids, contains a fresh water deposit, embracing shells of species identical with those now inhabiting the waters of Lake Erie.* This deposit consists principally of gravel, containing fragments and boulders of primitive rocks, but chiefly made up of water-worn fragments of the limestone itself. At some places, at the depth of from two to four or six feet, it is underlaid by a very fine deposit of clay, horizontally stratified, containing fragments of limestone similar to the rock beneath. It appears to belong to the extensive clayey deposit, which covers large tracts on the limestone range, and in which I have never met with any fossil remains; although they may, and probably will hereafter, be detected.

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* The Unios appear to be a thick-shelled species, and consist of water-worn fragments. I have not met with a single whole valve, although recently I had a good opportunity for examination, where an excavation for a mill-race was in progress; and likewise on Goat Island, where the bank had been undermined and caved off. They are exceedingly friable, and will scarcely bear handling. Some of the small univalves, however, as Melania, Planorbis, Paludina, &c., and one minute bivalve, which I take to be a Cyclas, are not only abundant, but well preserved, and probably inhabited the locality. The Unios may have been brought down by the river current.

The extent and power of these counter currents, which excavated the valley of the Niagara, and assisted in cutting down the ravine below the falls, remain to be determined, when the laws which govern the ebb and flow of tides shall be fully developed, and when the shape of this ancient gulf, at this stage of elevation, shall be approximately ascertained. It is well known, that the height and violence of tides are materially modified by the direction of prevailing winds, by oceanic currents, and by the shape of coasts and estuaries. At some places on the coast of England, as in the Bristol channel, the tide rises forty-two feet,* and in the Bay of Fundy, to the enormous height of from sixty to one hundred feet.† As no land which is now less than 575 feet above tide water, had then emerged from the ocean—unless its rise was less rapid than this region, and the reverse is probably true of the primitive districts—this arm of the sea had ample communication with the Atlantic, through the Gulf of St. Lawrence, and the valley of the Hudson. At this stage, the primitive range in the north of this State, and those in the New England States, were but islands; and it is not improbable, when the relative levels shall be ascertained, that other passes will be found, at a less elevation above tide water than Lake Erie. Receiving the tidal wave, therefore, through these different channels, which would meet in the vicinity of Lake Ontario, an additional impulse would be communicated to it, and a tide would probably result, little inferior to that at either of the places above cited.

There is another phenomenon connected with tides, which ought not to be forgotten. If, as suggested, this strait received a powerful tide, it might, when rushing up the narrow gorge above Lewiston, have produced that kind of tidal wave, called the "Bore," which, says Lyell,‡ "is sometimes produced in a river, where a large body of water is made to rise suddenly, in consequence of the contraction of the channel. This wave terminates abruptly on the inland side, because the quantity of water contained in it is so great, and its motion so rapid, that time is not allowed for the surface of the river to be immediately raised by means of transmitted pressure. A tide-wave thus rendered abrupt, has a close analogy, observes Mr. Whewell, to the waves which curl over and break on a shelving shore." This phenomenon takes place in the river Severn, which enters the Bristol channel, where the Bore, during spring tide, is sometimes nine feet high, and rushes up the channel with extraordinary rapidity.* It also occurs in the Ganges, the Burrampooter, and the Hoogly rivers; sweeping off herds of cattle, or whatever else may be overtaken in its course, and occasions more or less interruption to the safe navigation of all these streams.†

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* Lyell's Geology, Vol. I, p. 238.

† See Audubon's Birds of America, Vol. II, p. 448. Also, American Journal, Vol. XV, p. 132. Also, Rees's and the American Encyclopedias.

‡ Lyell's Geology, Vol. I, p. 274.

At any rate, the tide in the vicinity of the Niagara must have been very considerable; and its power, combined with the dashing of the waves, seems to be the only rational cause which can be assigned for the excavation of the numerous ravines already noticed. In a paper by Mr. James Geddes, read before the Albany Institute,‡ the fact, that they owe their origin to other than existing causes, is clearly established.

When the elevation had so far advanced as to confine the current exclusively to the valley of the Niagara, and the channel below the present falls sufficiently deepened to receive and confine the tidal wave within its rocky walls, a power was brought into active operation which it is difficult fully to conceive without witnessing its effects on some of the iron-bound coasts of this continent. The basin of Mines, and its vicinity, at the head of the Bay of Fundy, would probably be a fit place to study the effect of causes which were once active here.

When we contemplate these powerful agents, which, in every country, have had so much to do in shaping the surface of the earth, and consider, that in the natural order of events they must have been active here; when we find the proofs of their visitation engraven in characters as enduring as the continent itself, we can hardly doubt that they played an important part in excavating the deep channel below the falls. And when we contemplate them acting in concert with the river current, we cease to wonder that the chasm should have attained its present length and depth, and that the cataract should occupy a place at the distance of seven miles above its apparent natural position.

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* Lyell's Geology, Vol. I, p. 274.

† Rennell, see Philosophical Transactions of the Royal Society, 1781.

‡ See American Journal, Vol. II, p. 213.

How much is due to each agent separately, can hardly be determined. We must bear in mind, however, that the fall was nothing at first; that as the elevation advanced, the river became more rapid; that finally, when the limestone was cut through and somewhat undermined by the disintegration of the shale below, and not till then, a distinct cataract could have been produced. Until then, the tides and dashing of the surf were probably most efficient in tearing up the strata from their rocky beds, and comminuting the fragments; while the river would guide the course of their operations, and remove the detrital matter from its bed.

What distance the cataract has receded since that time, is a problem equally difficult to solve; but there are some indications which will enable us to approximate to the truth. The rapids above the cataract, and the whirlpool below, are points where phenomena exist incompatible with the common theory. If it should be established, that the conformation of the whirlpool is such, that it could not have resulted on the theory of recession, this "endless saw" must relinquish its claim to four long miles of excavation for which it has received credit. And if the rapids above the cataract existed prior to its present location, we may presume that they are but the upper extremity of an ancient inclined plane, or rather, succession of ledges, which existed before the limestone strata were cut through.

Goat Island is situated on the brink of the precipice, and divides the water into two unequal sheets. It is based on the limestone ledges which form the rapids, and the highest part of its surface is on a level with the river above their commencement. Near the upper extremity of the island, the rocky bed rises just sufficiently above the surface of the river to divide the stream, and deflect the branches somewhat from the original course of the current. It is to this circumstance alone that the island owes its existence; for its lower extremity is covered with a tertiary deposit of gravel and clay, which can offer no adequate resistance to the boisterous current, which seems anxious and ready to sweep the whole island into the gulf below.

Wherever the strata come in sight on the island, they conform to those in the bed of the rapids, and are equally water-worn and denuded. A portion of rock, recently uncovered by the encroachment of the rapids upon the west bank of the island, presents the same features, and can only be distinguished from those which have buffeted the fury of the torrent from time immemorial, simply by the knowledge of the naked fact of their recent exposure. One of the principal ledges, also, which extends entirely across from the Canada shore, may be traced some distance into the island; and its water-worn and ragged masses, projecting above the soil, afford conclusive proof, that the conformation of the bed of the rapids, and the surface of the rock which underlies the tertiary on the island, was effected by the same agent and at the same time.

No rapids could then have existed at this place, for the island has since received a tertiary deposit of clay, horizontally stratified, which is overlaid by one of gravel containing fresh water shells. These two deposits, at the lower end of the island, between the cataracts, measure thirty three feet in thickness. I have already mentioned, that this clay resembles the numerous beds in this vicinity; they all probably belong to the same general deposit. Mr. Rogers thinks this deposit took place from the waters of a tranquil lake.* The fact, however, of its containing gravel stones and water-worn fragments of the rock on which it rests, (as do all of these beds,) would seem to indicate a different origin. I suspect this clayey deposit may have been brought on by the overflowing of tides, after the rocky bed had become so much elevated as to be protected from the violence of the surge. The surface, where large tracts are overlaid by it, is marked by meandering swales, which strike the observer as fit channels to conduct the water back to its proper level at ebb tide, after having parted with a portion of its sedimentary matter. No proof surely could be more conclusive than these tertiary beds on Goat Island, that the *rapids* have not receded,—whatever may be the fact in regard to the cataract itself.

From the Falls to the Whirlpool, a distance of about three miles, I have observed no indications which have a direct bearing on the question of recession; but at this latter place, phenomena are presented perfectly incompatible with that theory. To enable the reader more clearly to comprehend the features of this singular spot, and also of the Devil's Hole, one mile further down the river, the following wood cut is introduced.[*]

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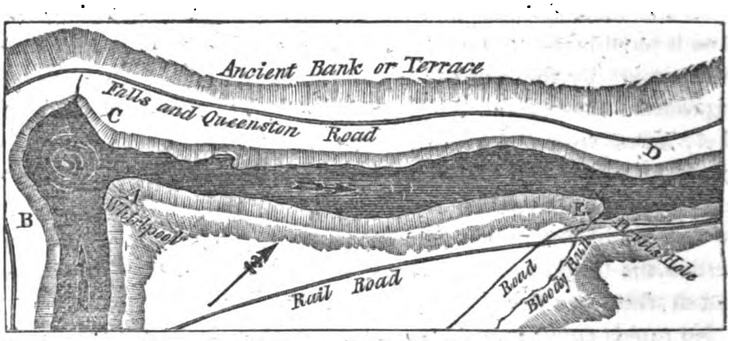
* American Journal, Vol. xxvii, p. 330.



I wish to call attention, particularly, to the dry ravine which enters the Whirlpool from the northwest. It has a gradual ascent from the bed of the river to the level of the surrounding country, and disappears east of the road from the Falls to Queenstown. It is similar, in all respects, to those which indent the general line of the escarpments from Hamilton, U. C., to Lockport, N. Y.,[†] and was evidently produced by the same means. Had this ravine been excavated by a branch of the river, which discharged its waters into the basin of the whirlpool, we could surely trace its bed a greater distance than one mile; and instead of a gradual ascent, we ought to find the limestone ledge projecting over the whirlpool, as it does over the basin, into which the river now tumbles. It will also be observed, that the direction of this ravine is a continuation of the course of the river where it enters the whirlpool. It is manifestly impossible, therefore, by any position of the cataract, to bring the action of the river to bear upon its upper extremity, where it is wholly within the limestone ledge. If the cataract was placed across the river from A to C, the current would be drawn in that direction; if from A to B, it might undermine the bank where the ravine is situated; but the more violent its action, the steeper would have been the escarpment. In either case, the ravine could not have been formed.

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[*] Taken, (but somewhat corrected,) from a map of a contemplated ship canal around the Falls of Niagara, by Lieuts. T. F. Drayton and J. G. Reed, U. S. Army.

[†] American Journal, Vol. XI. See wood cut, p. 215. Also Vol. XIV. See map of Welland canal district, by William Hamilton Merrit.

But let the reader suppose the river flowing nearly on a level with its banks; the high prominences, A, B, C, directing the course of its current, and the less elevated bank, near the ravine, flooded at high tide. Let him imagine such a tidal wave as the Bore, or even an ordinary flow of a few feet rise, meeting the current of the river at this place, and he will readily perceive, that both currents would be deflected towards the ravine, which, as the elevation advanced, would be left dry at its upper extremity, and new portions of its rocky bed exposed to the watery friction. When the bed of the river at the whirlpool had sunk below the limestone strata, we may suppose the inclined plane, to which I have alluded, and of which the present rapids formed the upper extremity, had attained its greatest extent. The more rapid disintegration of the shale would then undermine these harder strata, and the work of recession commence; but whether at, or above the whirlpool, I have no data on which to form an opinion; certainly not below, however.

There are other indications, further down the river, which strongly corroborate these views. The indent on the American side, called the Devil's Hole, is a notch, embracing about two acres; and to those who have not seen the place, its name, perhaps, may convey some idea of its gloomy and forbidding aspect. It is difficult to account for the excavation of this notch on any supposition but that of a force applied in the direction of the river from below. By inspecting the wood cut, it will be perceived, that it is but the continuation of the gorge; and this strikes the beholder with peculiar force when standing on the point E, and looking down the river. The high bank, also, on the opposite shore, marked D, occupies a position well calculated to deflect the tidal wave directly into this notch. Bloody Run, which is laid down as entering the river through this chasm, drains but a few hundred acres, and is so situated, that a branch of the river could never have flowed through its channel; were it not so, the thick bed of clay and gravel, which occupies the surface to within a few feet of the precipice, would be equally conclusive against the supposition. Its bed is perfectly dry, except during wet seasons of the year; and it cannot be supposed to have done much towards this gigantic work of excavation. The name of this stream seems to be in very good keeping with that of the gorge, through which it enters the river, and was given in commemoration of a tragic scene once enacted at this place.*

When the passes by which this inland sea communicated with the Atlantic, became contracted and shoaled, by the progressive elevation of the continent, it approximated to the condition of a lake. The same process which took place when this limestone reef emerged, was repeated, but in a new place. The tides and waves began to spend their force on obstructions at a lower level; and when the plain, on which Lewiston is situated, emerged, it is probable the change was nearly effected.

We there find indications of an ancient shore, composed of rounded beach gravel, elevated a few feet above the general level of the surrounding surface, and having a direction parallel to the present shore of Lake Ontario. It is generally supposed—and the geologist assigned to this district, in the survey now going on, favors the opinion†—that Lake Ontario once had a greater elevation than at present, and was on a level with this ancient beach, and that, from some unexplained cause, it has subsided to its present level and dimensions.

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* The following brief account of that bloody exploit, as related by Farmer's-Brother, a celebrated Seneca Chief, who himself headed the attacking party, is extracted from Thatcher's Indian Biography, and may be interesting to some of the readers of this journal who have not seen that work. "There, with a party of Indians, he lay in ambush, patiently awaiting the approach of a guard that accompanied the English teams employed between the Falls of Niagara and the garrison," (Fort Niagara,) "which had there lately surrendered to Sir William Johnson. The place selected for that purpose is now known by the name of the Devil's Hole, and is three and a half miles below the famous cataract upon the American side of the strait. The mind can scarcely conceive a more dismal looking den. A large ravine, occasioned by the falling in of the perpendicular bank, made dark by the spreading branches of the birch and cedar, which had taken root below, and the low murmurings of the rapids in the chasm, added to the solemn thunder of the cataract itself, conspire to render the scene truly awful. The English party were not aware of the dreadful fate that awaited them. Unconscious of danger, the drivers were gaily whistling to their dull ox-teams. Farmer's-Brother and his band, on their arrival at this spot, rushed from the thicket that had concealed them, and commenced a horrid butchery. So unexpected was such an event, and so completely were the English disarmed of their presence of mind, that but a feeble resistance was made. The guard, the teamsters, the oxen and the waggons, were precipitated into the gulf. But two of them escaped; a Mr. Stedman, who lived at Schlosser, above the falls, being mounted on a fleet horse, made good his retreat; and one of the soldiers, who was caught on a projecting root of a cedar, which sustained him until assured, by the distant yell of the savages, that they had quitted the ground. It is the rivulet, pouring itself down this precipice, whose name is the only monument that records the massacre. It is said to have been literally colored with the blood of the vanquished."

† Mr. James Hall: see New York Geological Report, 1838, p. 310, and onward.

I have long suspected some fallacy in this theory, and have anxiously awaited the result of accurate levelings. It may be deemed equally probable, and more consonant with the views here suggested, to suppose, that, after the principal tides were shut out from this inland sea, and the water had become nearly or quite fresh, but while it was on a level, or nearly so, with the Atlantic, the uplifting process became stationary, for an indefinite period; during which season of quiescence, this beach was thrown up. At some subsequent time, the disturbing force again became active, raising the basin of Lake Ontario, above the further influence of the ocean; and fixing the present levels and boundaries of this part of the continent. Should the statement of Mr. James Hall prove well founded, and actual admeasurement confirm the estimates of his assistant, Dr. George W. Boyd, this view of the subject will be clearly established; although these gentlemen do not seem to have drawn such an inference. Mr. Hall states the elevation of the ridge in Niagara county, at about 160 feet; and admits variations in its level, of a few feet.* Dr. Boyd estimates its elevation in Wayne county at more than 200 feet.† If this diversity of level actually exists—as I have long suspected would prove to be the case—it fixes the elevation at a period subsequent to the formation of this beach. Its increased elevation, in approaching the primitive district, is what should be inferred, on the theory, that those districts were the original centers of elevation. And the variation of forty feet in about one hundred miles, is quite as much as ought to be expected from an elevation of but four hundred feet, which is the height of this ridge, or ancient beach, in Niagara county, above tide water.

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* Second New York Geological Report, p. 310. † Ibid. p. 312.

## ART. VI.—*On Electro-Magnetism, as a Moving Power;* by CHARLES G. PAGE, M. D., Washington City, D. C.

AFTER the first successful magnetization of soft iron by the galvanic current, and more especially on the announcement of Prof. Henry's signal experiment, the suggestion naturally occurred to every enquiring mind, cannot this immense attractive power, so easily developed and controlled, be rendered available as a mechanical agent? The first successful step towards the attainment of this object, of which we have any record, was made by Mr. William Sturgeon, a distinguished philosopher of England. The next original invention by which an independent motion was obtained from electro-magnets, was the oscillating apparatus of Prof. Henry, described in a previous No. of this Journal. The next invention of any note, was that of Dr. Ritchie, now very well known as Ritchie's revolving magnet. This ingenious and simple contrivance, will always be regarded as a superb philosophical apparatus. It does not exhibit that astonishing rapidity of rotation; as if its poles were changed by the use of solid conductors, but as an instrument is more pleasing, as it shows at the same time the magnetic rotation, the vivid sparks, and in the dark a beautiful optical illusion. Some time after the announcement of this instrument in this country, Mr. Davenport of Vermont published in this Journal a partial description of an electro-magnetic engine of considerable power. It appeared that Mr. Davenport had for a long time been occupied in the subject, and was not aware of what had been previously effected by others. Some time prior also to this period, some interesting experiments were described in this Journal, by Dr. Edmondson of Baltimore, and, indeed, this gentleman appears to have been the first in this country who produced a rotary electro-magnetic machine. Since the announcement of Mr. Davenport's invention, the innumerable experiments which have been performed in this country, in England, on the continent of Europe, and even in the East Indies, have all contributed to prove that the smallest engines which have been made, have had by far the greatest proportionate power. Since I first gave the subject any attention, I have had sixteen different models constructed, each involving distinct principles. From all these experiments the inference is still the same, viz.

*the fewer the magnets and the smaller their size, (with certain limits,) the greater the ratio of mechanical power obtained.* Such experience as this appears discouraging, but is by no means sufficient to prove the experiment infeasible. The numerous failures are such as have been incident to the prosecution of all inventions in their early stages. It is much to be regretted, that in our country the invention should be a subject of mercenary speculation, when in reality it has no value except as an experiment, and that the public have been so far misled, as to withdraw that countenance and encouragement which the experiment really merits. We can not but deplore, that such an interesting branch of science should be so traduced, and that the very name of electro-magnetism should be coupled with empiricism.

There can be no doubt in the mind of any one who may have seen an electro-magnetic engine, that it furnishes a mechanical power already applicable and useful to a certain extent, provided the maintenance of that power be not expensive and difficult. The application of this power cannot be expensive, *if the mechanical or working power of any number of magnets in a machine increase in the direct ratio of the aggregate attractive force*; that this rule does not hold in any of the plans of which, hitherto, we have had any description, I shall prove, when the *cause* comes to be considered. Yet in certain arrangements this law must obtain, and although the necessary construction be at present somewhat complicated, yet ultimately it doubtless will be simplified. At present, we have no means of computing the extent of magnetization which may be effected by a galvanic pair of given surface, say a single inch, freshly immersed. It must very far exceed that which we ordinarily recognize in our experiments. By great care, I have succeeded in producing an attractive force of over 800 pounds, by a galvanic pair having only ten square inches of zinc exposed; whereas with the usual arrangements, it required two or three square feet to produce the same power. This power, though so great for the means used, yet probably was not near the maximum procurable from the same zinc surface. It would seem, then, that if the above mentioned ratio exists in attainable forms of machines, the application of the power cannot be otherwise than cheap. The difficulty of maintaining a uniform power is by no means insurmountable. The faults hitherto have been, the wearing and alloying of the pole-changer and springs, and subsidence of battery action, which are easily demonstrated to be remediable. It is not to be presumed that in the present age, or perhaps ever, we shall arrive at a power from electro-magnetism, which shall supplant the steam-engine, in its grander operations. Indeed, it is not essential that this should be the case, to render the invention even invaluable. Incalculable benefit would be conferred upon society, if a new and simple mechanical power could be procured, available from that of a single man to one or two horses. A multitude of mechanical operations are now carried on by animal or water power, for which a low steam power cannot well be used, from the fact that steam-engines below one horse power, are hardly worth the making, and are troublesome and expensive. A very natural question here arises; if one horse power can be obtained by electro-magnetism, why cannot two horse, or any extent of power, be made? Theoretically considered, it can be; and electro-magnetic powers can only be limited by the means used. But practically we have already been taught, that (unlike other powers, where the largest engines are the most simple and least expensive) electro-magnetic engines above a certain limit, increase in complication and expense in a much greater ratio than the power obtained. To ascertain this limit, the precise point where economy ceases, is now the great, and ought to be the only object of research.

There seems to be little doubt, from the data we already possess, that a power equivalent to one horse may be obtained *with* economy. Before proceeding to point out the obstacles in the way of the application of this power, the following general rules are offered as deduced from actual experiment.

*First.*—Whatever be the rate of passage of the galvanic current, the full magnetization of a bar of iron requires time in proportion to its hardness and *size.* Mr. Wheatstone has calculated the rate of electro-motion, in good conductors, to be 188,000 miles a second. Admitting that electricity, even in its lowest state of tension, passed at this rate, still the time required in giving a very large magnet its maximum charge, would be a perceptible item. Therefore a single impulse or discharge, as from a common electric battery, (be the quantity ever so great,) scarcely magnetizes. The necessary consequences of this law are, first, small magnets answer better than large; second, change of poles, to produce motion, must be dispensed with, if the introduction of repulsive powers be not more than sufficient to compensate for the loss; third, the power of a machine does not increase with its velocity.

The *second* general rule is, that integrity of the conducting and magnetizing wires, is of the utmost consequence. By integrity, I mean not only entire absence of flaws, fractures, and imperfectly soldered joints, but a perfect molecular arrangement. Bending or twisting a wire, impairs its conducting power; and a wire which has once been wound upon a magnet, is not fit for the same purpose again.

*Third.*—It is well known that the repulsive power is not equal to the attractive, of the same magnet, be it even of the hardest steel. The difference between the two forces is still greater in electro-magnets, and for the same reason. There is also another cause which operates to diminish the repulsive forces of electro-magnets, which will be considered when treating of the influence of secondary currents.

*Fourth.*—Two electro-magnets, unequally charged, attract each other, even when similar poles are presented. The same is true of the steel magnets, but not to so great an extent.

*Fifth.*—Change of poles cannot be introduced in a machine, for the following reasons: 1. It requires time; and during this time, the magnets which change poles, are attracted and retained somewhat by those which do not change. 2. Similar poles will attract and produce back action; for, unless the magnets which change poles be favored by excess of battery, or superior conductors, they cannot receive near the same charge, as those which do not change: for, first, there is magnetism of an opposite character to be overcome; and secondly, two breaks in the galvanic circuit are necessary to produce change of poles. 3. Two magnets which have a statical repelling power, that is, a power which will merely keep them asunder when the machine is at rest, will attract each other when the machine is in motion. This singular fact is a consequence of secondary currents, shortly to be described.

The next law to be observed is, that the sum of the forces of any number of magnets charged by one battery, is in a diminishing ratio to the forces of one magnet charged by the same battery, provided the battery be not in excess. Hence there must be a great loss of power, when a number of magnets are charged by the same battery. The secondary current has also an important bearing upon this case.

One of the greatest obstacles we have yet to encounter, in the prosecution of this subject, is the influence of secondary currents to diminish the power of a machine, just in proportion to the use of those which at present we consider the most obvious means of increasing the power. By secondary currents are here meant, those currents which flow in the conducting wires, either with or against the battery current, and are consequences of the development or cessation of magnetism, or of the approximation or recession of two charged magnets. These currents are found to obey the following laws.

The battery power remaining the same, the more coils surrounding the magnet, the greater the power of the secondary current.

After one coil has been wound upon a magnet, the addition of a second coil increases the power of the secondary current in a greater ratio than the power of the magnet. Hence, as it has been found, some machines have had greater power with two coils of wire on the magnets than with four or five; although actual experiment proves, that the real or statical power of the magnets is considerably greater when a large number of coils is used. According to Faraday's interesting discoveries, when magnetism is developed in a bar of iron inclosed within a helix, a secondary current flows in the helix contrary to the battery current. When the magnetism ceases, the secondary flows in the same direction as the battery current. The development of magnetism is equivalent to the determination or movement of magnetic forces towards the poles. The cessation of magnetic power is equivalent to the retreating of those forces. Now the approximation of two electro-magnets attracting each other, occasions an additional movement or accumulation towards the poles, and consequently develops a secondary current flowing against the battery current. The power of this current is in proportion to the velocity with which the magnets approach each other.

When two such magnets in proximity or contact are separated by mechanical force, a recession of accumulated forces takes place, and consequently a secondary is developed, flowing in the same direction as the battery current. Therefore, an independent motion of an electro-magnetic machine diminishes the influence of the battery current in proportion to its velocity; whereas the application of mechanical force to drive the machine against its own motion, contributes to the magnetizing power of the battery. The same rule applies to the motion of repelling poles.

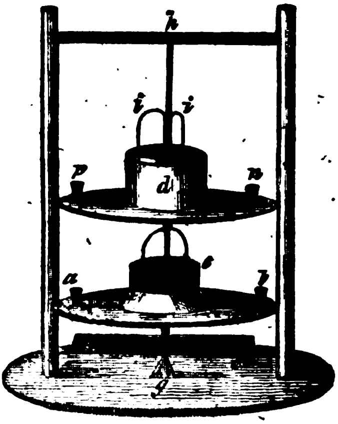
When two repelling electro-magnets are made to approach each other, a recession of the magnetic forces takes place, and consequently a secondary current is developed flowing in the direction of the battery current. While the forces are thus kept in retirement, if the two magnets be made to recede, they will again be determined towards the poles, and consequently the secondary will flow against the battery current. By taking advantage of these laws, I was led to the invention of a new instrument (Magnetic Electric Multiplier, described in the last number of this Journal,) in which, the secondary current may be so applied as to diminish or accelerate the velocity of the revolving bar.

It will now be readily seen, that two electro-magnets, with a statical repelling power sufficient to keep them asunder, would cease to repel when the machine is in motion. The attractive forces constitute the paramount motive power, and when the velocity of the machine exceeds that which the repulsive powers alone would give it, they are of no value whatever, unless they operate in conjunction with attractive forces; but even where this is the case, the secondary current arising from the velocity of the machine, must occasion so great a disparity between the similar poles of the magnets which change and those which do not change, that attraction, in lieu of repulsion, must take place.

I have thus endeavored to point out the most important of those difficulties in the way of the application of this power, which necessarily arise from the connexion of galvanism and magnetism. There are many other hindrances entirely of a mechanical nature, which perseverance will doubtless overcome.

### ART. VII.—*Magnetic Electrepeter and Electrotome, to be used with flat spirals;* by CHARLES G. PAGE, M. D., Washington City, D. C.

THE figure represents a simple instrument, designed chiefly to aid the operator in exhibiting the magneto-electric properties of flat spirals. Though the flat spiral as a magnetic electrical instrument is inferior to the compound electro-magnet, described in the last number of this Journal, yet the phenomena are more interesting, as they are strictly magneto-electric, produced without the presence or coöperation of ferruginous bodies. The object of the instrument, as its name (electrotome) implies, is to break the circuit; and as it accomplishes this by changing the direction of the galvanic current, it is also a self-acting electrepeter.



A rotating electro-magnet would effect the same object; but the introduction of an electro-magnet or a coiled wire, in any part of the circuit, would detract from the value of the spiral. (*g*) is a thin base board of mahogany, which, when the instrument is in use, is to rest upon the spiral coil or the box containing it. At the centre of the base (*g*) is a pivot sustaining the magnetic bar of steel (*c*) and its axis, the extremity of which plays freely in the centre of the cross piece (*h*.) Between the upright pillars are secured two circular pieces of mahogany (*a b*) (*p n*) to serve as supports for the mercury cells (*d* and *e*.) The circular box (*d*) contains two concentric mercury cells, insulated from each other, and connected with the poles of a battery by the separate wires and cups (*p n.*) The centre of this box is open to admit the shaft of the magnet, as is also the centre of the box (*e.*) This box is made of two glass cylindrical sections, cemented into a groove of a turned cup or base of wood. It contains two cells for mercury nearly semicircular, and insulated from each other precisely as the cells for the Ritchie magnet. These cells are connected with the extremities of the spiral by the separate wires and cups (*a b.*) The two wires (*i i*) are well insulated by a winding of varnished silk, and secured in their positions on the shaft by silk thread. The upper extremities of these wires dip into the concentric cells of (*d,*) and the lower into the cells of box (*e.*) The base board is made thin, and the pivot (*g*) short, to allow the magnet to come as near as possible to the spiral. Place the instrument upon the spiral, make the connexions as above directed, and the magnet immediately commences a rapid rotation by the influence of the spiral. The instrument should always be placed without the centre of the spiral, and in such a manner, that the insulating pieces between the cells of (*e*) should be in the direction of a radius of the spiral.

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## Art. VIII.—*Observations on the Vascular System of Ferns, and Notice of a monstrous flower of Orchis spectabilis;* by J. W. Bailey, Professor of Chemistry, Mineralogy and Geology, at the U. S. Military Academy, West Point.

### I. *On the Vascular System of Ferns.*

It is a question of much interest in vegetable anatomy, whether spiral vessels exist in ferns; for if they do, ferns present a remarkable deviation from the usual structure of flowerless plants. It is well known, that the presence or absence of these vessels has been considered so invariably connected with the presence or absence of flowers, as to have given rise to the division of the vegetable kingdom into the two great classes Vasculares or Flowering, and Cellulares or Flowerless Plants. Ferns are by all writers placed in the last class, but it will be seen by the following quotations, that there exists much uncertainty with regard to their having spiral vessels.

Link, (Elemens de Botanique, T. I, p. 132,) as quoted by Hugo Mohl in his elaborate treatise "De Structura Caudicis Filicum Arborearum,"* states the wood to be "*almost wholly made up of large spiral vessels.*" Decandolle, (Organographie, T. I, p. 232,) as quoted by Mohl, mentions that they contain many annular ducts (vasa scalariformia) without alluding to spiral vessels.

Lindley, (Int. to Bot., 1st edit., p. 22,) speaking of spiral vessels, says, that "in flowerless plants they are for the most part altogether absent; the only exceptions being in Ferns and Lycopodiaceæ," and adds, "*in these they no doubt exist;* Mr. Griffiths has succeeded in unrolling them in *Lycopodium denticulatum.*"

Mohl, in the treatise above referred to, in which he describes and figures the *vasa scalariformia*, says, (p. 48,) "Num in junioribus plantis et in junioribus partibus adultarum harum plantarum vera vasa spiralia occurrant exponere nequeo, quum has partes inquirendi occasio defuerit;" and again, in a note on page 51 of the same treatise, he says:

"Schultzius quidem (Flora, 1828, Tom. I, p. 154) commemorat propria vasa inesse, ceterum accuratiori eorum descriptione omissâ; equidem vero in nulla earum formationem inveni propriis vasis adnumerandum."

When distinguished observers disagree so much in their statements, it often happens that their accounts can be reconciled by the discovery of some fact not observed by either, which will explain the apparent contradictions. I hope that the knowledge of the point of structure which I am about to describe, will have this bearing upon the present question; for it shows, that those who maintain the existence of spiral vessels in ferns, may actually have obtained, what, when not carefully examined, might easily be mistaken for spiral vessels; while those who deny the existence of spiral vessels, may have observed the same organs without attempting to uncoil them, or if they attempted they may have failed, owing to the age of the plant or some other cause.

The fact to which I would invite the attention of botanists is this, viz. *The ducts of ferns* (Annular ducts of Lindley, Vasa scalariformia of Decandolle and Mohl) *can be uncoiled spirally*

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* Published in the splendid work, Icones Plantarum Cryptogamicarum, quas in itinere annis 1817—20 per Braziliam collegit et descripsit Carol. Frideric. Philip. de Martius, Monachii, 1828—34.

*with great ease when the plant is young*, but with more difficulty in the adult plant. The uncoiled duct, when examined by a low magnifying power, has all the appearance of a common spiral vessel; but when highly magnified, it shows the real structure to be as represented in Fig. 4, Plate I. It will be seen, that this differs very much from the structure of a true spiral vessel, which shows merely one or more continuous, slender, round fibres, entirely destitute of any marks; while the uncoiled ducts of ferns show, as in the figure, a flat ribbon marked with parallel rows of short bars.

To obtain these ducts separate from each other, so as to allow the state in which they exist in the plants to be seen, I macerated in water for several weeks the bundles of vessels from the petioles of young and tender, though large fronds of *Onoclea sensibilis*, *Osmunda cinnamomea*, &c. until by the decay of the connecting parts, the vessels could be easily separated from each other by placing a portion on glass, in a drop of water, and forcing them apart with the points of fine needles. The vessels, as prepared in this manner, present the appearance of long cylindrical (Fig. 2, Plate I,) or prismatic (Fig. 3, Plate I,) tubes, terminating at *each end* in very elongated cones. These tubes vary much in length and diameter, some being several inches long and as much as one twenty-fifth to one twentieth of a line in diameter, while others are very minute and short. The sides of these tubes are marked with a great number of short parallel *bars*, placed in rows one above another, and the length of the bars in the same vertical row is often seen gradually to diminish, (Fig. 2,) so that the bars are finally reduced to mere points.

These bars are so placed as to incline slightly, often almost imperceptibly, upwards from left to right in all the ferns I have examined. The end of one bar is placed close to the end of one in the next row, so that the bars form broken spiral lines around the cylinder, and as the membrane of the vessel appears to be thinnest between the bars, it follows, that when a force is applied to tear this membrane, the laceration takes place in a spiral direction, and the vessel when thus torn, appears as in Fig. 4, Plate I. Vessels torn and uncoiled in this manner have, I presume, been mistaken by Link and others for true spiral vessels. This laceration and uncoiling can be effected with so much ease in *tender* shoots of *Onoclea sensibilis*, *Adiantum pedatum*, *Polypodium* *connectile*, and particularly in *Osmunda cinnamomea*, that if the petiole of the frond be snapped across and gently separated, hundreds of uncoiled ducts will be seen to connect the two fragments, as in Fig. 5, Plate I. These may often be drawn out to the length of two or three inches without breaking. When broken, they exhibit the curious peristaltic motion which has been noticed by Malpighi and others in true spiral vessels. This is evidently a mechanical effect, caused by the elongated and untwisted coil resuming its twisted state.

I have found the vessels above described, and have uncoiled them, in every species of fern which I have examined, among which are *Aspidium marginale*, *A. acrostichoides*, *Asplenium ebeneum*, *Onoclea sensibilis*, *Adiantum pedatum*, *Pteris aquilina*, *Osmunda cinnamomea*, *O. regalis*, *Polypodium connectile*, *P. vulgare*, *Botrychium virginicum*, *and others*. From the drawings given by Mohl; (Table XXXI, Fig. 1 to 3, *m m*, Table XXXV, Fig. 1,) it is evident, that the structure of the vessels in the arborescent ferns is similar, although it does not appear that any attempts have been made to uncoil them.

In all the ferns which I have examined, I have sought in vain for any thing approaching more nearly to true spiral vessels than the lacerated ducts above described.

As these ducts have precisely the structure which would result from a compound spiral vessel, in which the spiral threads should be broken into short bars, I have carefully examined many young ferns, to determine if in the young state the bars may not be continuous, and thus form a true spiral vessel. But I have found little to support this view, except the appearance of very small ducts when so torn as to include only a single spiral line of bars, in which case it is often impossible to see whether the bars are connected or not.

I hence infer, that spiral vessels do not exist in ferns, and that the ducts when torn spirally have been mistaken for them.

In connection with the above observations, I examined the young stem of *Equisetum sylvaticum*, in which I distinctly and repeatedly found small vessels which could be uncoiled spirally, and which presented no appearance of the bars seen in ferns, but which certainly *appeared* to be true spiral vessels. I did not detect them, however, in *E. hyemale*, or in *E. palustre*.

I have not yet examined the Lycopodiaceæ in a young state.

## II. *Notice of a Monstrous Flower of Orchis spectabilis.*

Although no doubt is at present felt with regard to the normal structure of the Orchideæ, yet the instances in which this structure is reverted to in monstrous flowers, are interesting and worthy, I think, of being recorded. An instance of this kind in *Orchis latifolia*, is described by M. Achille Richard, in the "Memoires de la Soc. d'Hist. Nat.," of Paris, in which the flowers were perfectly triandrous, with no trace of irregularity in any part of the floral envelopes.

I myself found a fine example in the case of a monstrous flower of our beautiful *Orchis spectabilis*. The plant on which it occurred was a very luxuriant one from the Crow's Nest, West Point, supporting six or seven flowers, of which all but one had the ordinary structure. That one, however, had three stamens perfectly formed, and each presenting *precisely* the same appearance as the one usually developed. All the other parts of the flower were perfectly regular, and the ovarium had the three ordinary placentæ. For a sketch of this flower see Fig. 6, Plate I.

### EXPLANATION OF PLATE I.

Fig. 1. Conical terminations of ducts in ferns. The ducts terminate at *each* end in such cones.

Fig. 2. Cylindrical portion of a duct, showing the bars gradually diminishing to points.

Fig. 3. Prismatic portion of a duct. This form is probably caused by the pressure of surrounding parts.

Fig. 4. A duct of ferns torn in a spiral direction between the bars and uncoiled. In this state, ducts have probably been mistaken for spiral vessels.

Fig. 5. Two portions of the bundle of fibres in ferns, broken apart and gently separated, showing several torn ducts spirally twisted, still connecting the parts.

Fig. 6. A monstrous flower of *Orchis spectabilis*, showing a return to the normal structure of Orchideæ, having three perfect anthers, and the rest of the flower in the ordinary state. *a*, *a*, *á*, three anthers not differing in any respect from the one usually developed, and having a very dilated stigma in front of them. *b*, *b*, *b*, Sepals. *c*, *c*, *d*, Petals and lip. *e*, Spur. *f*, Ovarium.

## Art. IX.—*On Fossil Infusoria, discovered in Peat-earth, at West Point, N. Y., with some notices of American species of Diatomæ;* by J. W. Bailey, Prof. Chem., Mineral. and Geol. at the U. S. Mil. Acad., West Point.

Through the kindness of my distinguished friend Dr. Torrey, I received some months since a portion of the fossil Infusoria, of the tribe Bacillariæ, recently discovered by Ehrenberg, constituting whole strata in Germany, &c. The specimen I received, came originally from Ehrenberg himself, and was brought to this country by Prof. Daubeny of Oxford.

Having by means of this specimen become acquainted with the form of these singular creatures, I was led to search for the living species of this family in various situations in this vicinity. I soon found that they were exceedingly abundant, occurring not only in small streams and stagnant pools, but also nestling in the wet moss on moist rocks.

The situation, however, in which I found them to be most abundant was in the bunches of *Conferva*, *Zygnema*, and *Batrachospermum* which constitute the green slimy matter known vulgarly by the name of *Frog-spittle*, so abundant in bogs and slow running brooks. They were accompanied by great numbers of the *Diatomæ*, particularly *Diatoma flocculosum* and *Fragillaria pectinalis*. By burning off the vegetable matter from a bunch of the *Confervæ* and examining the ashes with a good microscope, I found them chiefly composed of the siliceous shells of various loricated Infusoria, and what was to me before unknown, I found that the *Diatomæ* were also unchanged by fire or acids, and consequently like the Bacillariæ composed of silica.*

The imperishable nature of the Bacillariæ and Diatomæ, led me to suppose that large numbers must be buried in the mud at the bottoms of the bogs, streams, &c., where the living specimens occur, but I was not prepared for the discovery which I shortly made of *a deposit eight or ten inches thick and probably several*

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* Since making this observation I find that the same discovery had been previously made by De Brèbisson; see extract from Meyen's Report given at the end of this article.

*hundred square yards in extent, which is wholly made up of the siliceous shells of the Bacillariæ, &c. in a fossil state.*

This deposit is about a foot below the surface of a small peat-bog, immediately at the foot of the southern escarpment of the hill on which the celebrated Fort Putnam stands. In draining this bog, a large ditch was dug, and among the matter thrown out, my attention was attracted by a very light, white or clay-colored substance, which when examined closely in the sun-shine, showed minute glimmering linear particles. On submitting it to observation, by means of a good microscope, I found it to be almost entirely composed of fossil Infusoria, with occasionally a few fragments of a Diatoma or Fragillaria.

I have since examined many specimens, taken from different and distant parts of the same bog, and have invariably found the same siliceous bodies, and in the same abundance.

There can be no doubt that in this place there are several tons of the shells of beings so minute as to be barely visible as brilliant specks, when carefully observed in a strong light by the naked eye. Hundreds of years must have elapsed before such an accumulation could have been made.

The forms most abundant in this peat-earth are represented on Plate 2. Fig. 1, represents one of the Bacillariæ, which is apparently identical with fossil specimens from Ehrenberg. Fig. 2, represents a boat-shaped shell, which like the preceding is marked with parallel lines of almost inconceivable fineness. Fig. 3, shows a smooth siliceous body whose nature is to me unknown. Fig. 4, is a rough siliceous body of whose nature I am also ignorant. With these occur great quantities of exceedingly small rings, discs, and spheres, see Fig. 11, Plate 2.

All these forms together compose a white or clay colored mass, which when dry feels very light, does not effervesce or dissolve in acids, and is not fused by the blow-pipe. I have no doubt that this substance will be found abundantly in many peat-bogs, and I hope in the next number of this Journal to see the announcement of its discovery in many localities.* From its white color, it may in some cases have been confounded with marl, from which its action with acids would distinguish it. To examine for the Infusoria, diffuse a small portion in a drop of water, and examine with a microscope of high power. The very convenient Raspail Microscope is well suited for the purpose, but to see the fine lines on these shells most distinctly, a small glass sphere made according to the method of Torre of Naples, should be used with the Raspail fixtures.*

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* Since writing the above, I received from my scientific friend, O. Mason, Esq., President of the Providence Franklin Society, a letter from which I take the liberty to extract the following. He says, "your microscopic examinations of the white substance occasionally found at the bottom of peat-bogs have afforded a satisfactory and very curious solution of a phenomenon which has often occupied my mind. I could

As I have not had the good fortune to obtain Ehrenberg's papers on Recent and Fossil Infusoria, I am unable to give the names of the species occuring at West Point. I have, however, made sketches of the principal forms occuring in the peat-earth, which I hope will serve to make these singular beings more generally known and perhaps also enable those who have Ehrenberg's papers, to identify our species. All the Infusoria figured on Plate 2, occur abundantly in company with the Closteria, and several other forms, in a living state, in the waters near the deposit of fossils. Fig. 5, represents the species which appears *most* abundant as a *recent* species, and *least* abundant as a *fossil.*

As the species of Algæ known as the Diatomæ, have also a siliceous shell and occur abundantly in our ditches, &c. in a recent state, and occasionally in the peat-earth in a fossil state, and as this obscure but beautiful tribe appears to have been wholly neg-

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not even conjecture the origin of this sedimentary accumulation, which generally occurs under circumstances which afford no clew to its source. * * * I have forgotten all the localities whence the specimens were obtained, which were put into my hand by various individuals some years since, some of whom supposed it to be magnesia and others porcelain earth."

* I make these spheres by drawing into a thread a portion of green glass (flint glass will not answer, as the lead reduces,) and then snapping off a portion, about half a line or a line in length, I lay it upon a fragment of charcoal and very carefully direct upon it the flame of a blow-pipe, observing to cease to blow the moment that the bit of glass has assumed the spherical form, (otherwise ashes adhere, and the glass becomes full of flaws.) The spheres are then easily set in lead, thus: Make a conical depression in a piece of sheet lead and perforate the apex of the cone with a hole somewhat less in diameter than the glass to be set. The glass is then to be forced into the hole so as to project through slightly. I have frequently made, and set in five minutes, spheres in this manner, which would magnify from one hundred, to four or five hundred times the diameter of the object. Such glasses are much superior to any usually kept for sale in this country. I presume that these glasses would have been more used, had they been tried with the proper arrangements for light. With the beautiful fixtures of the Raspail Microscope they leave little to be wished for, either with regard to power or the distinctness of vision.

lected by American botanists, (but one species, D. flocculosum, being credited to our Flora,) I have made sketches of several species, which occur abundantly about West Point.

I have found abundantly in this vicinity, *Diatoma flocculosum*, Fig. 12, Plate 2, another species, *D. tenue*, having the articulations six to eight times as long as the diameter, Fig. 13, Plate 2, *Diatoma crystallinum?* Fig. 14, Plate 2, *Fragillaria pectinalis*, Fig. 15, Plate 2, and *Meridion vernale?* of Agardh, Fig. 16, Plate 2. My specimens of the latter, found in Washington's valley, agree precisely with specimens sent to Dr. Torrey, by Dr. Binders, and marked *M. vernale*, Agardh, but Agardh's description, does not suit them well. Perhaps this may be the *M. circulare* of Agardh.

I have also found, adhering to specimens of Algæ, collected near Providence, by my friend D. C. Cushing, a great quantity of *Meloseira nummuloides*, Agardh. This is another species of the tribe Diatomæ. It appears then, that this tribe is quite abundant in this country, and a monograph of the species occurring in the United States, is much to be desired.

In connection with the above, the following extracts from Meyen's Report of the Progress of Vegetable Physiology,* during the year 1836, will prove interesting. I met with it several weeks after I made the observations above noticed.

"Mohl confesses, that after many years' observation he still remains quite in doubt as to the place which the *Bacillariæ* should occupy; that however their increasing by separation, does not justify us in classing them as animals.

"I may also mention that Link, Unger and Morren, have of late remarked, that these doubtful creatures which are known under the name of *Bacillariæ*, ought to be arranged with vegetables; according to this, there would remain no other botanist, with the exception of Corda, that had paid any considerable attention to vegetable anatomy, who did not consider the *Bacillariæ* to be plants.

"From this we may judge of the contradictions on this subject which are found in the reports edited by Wiegmann and myself, on the progress of zoology and physiological botany for the year 1835,†—as these creatures are at times mentioned as plants, at times as animals, and indeed under quite different denominations.[*]

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* Wiegmann's *Archiv für Naturgeschichte*, 1837, Part iii. Translated in Lond. and Ed. Phil. Mag., Oct. 1837, page 381.

† Wiegmann's *Archiv*.

"Morren, in the highly important memoir on the *Closteriæ*,[†] has very fully treated the question, whether they should be arranged with animals or vegetables; he succeeded by employing very high magnifying powers, in showing that those red and very movable little points discovered by Ehrenberg at the ends of these beings, were nothing else than minute vesicles which afterwards change into new individuals. It was these movable, and as it were, oscillating points, which were considered as organs of motion, and appeared to justify the placing of the *Closteriæ* among animals, which, however, at present, after Morren's discovery, falls to the ground. Besides the occurrence of these self-moving propagula in the interior of the *Closteriæ*, Morren has observed a formation of fruit by conjugation, quite similar to the mode of formation of the fruit in the *Conjugatæ*,[‡] and besides this there also takes place an increase of the *Closteriæ* by separation.

"The siliceous envelop which surrounds the *Closteriæ*, as well as all other *Bacillariæ*, is regarded by Morren as a formation analogous to the so called *cuticula* of plants, a fact which is capable of confirmation only in certain relations; for in the perfect plants this fine plate of silica lies in the substance of the *cuticula*, and is only separated from this by the destruction of the organic parts. Besides this siliceous envelop, Morren supposes the existence of two other distinct membranes, which form the cuticles of the *Closteriæ*, and inclose the green substance; he however remarks, that they only become evident upon the metamorphosis of the plant. I consider the inner pellicle to be the analogue of the inner envelop which is found in the members of Confervæ when their spores are ripened, or they begin to increase in any other manner, as for instance, by excrescence and separation. Morren thinks it possible to explain the motion of the *Closteriæ* by the action of opposite electricities. The author also gives a very complete description, accompanied by drawings, of the very manifold forms which the *Closteriæ* exhibit at different periods; and by this he shows, how at least six of the new species of the genus *Closterium*, described by Ehrenberg, belong to one and the same species.

"De Brébisson[§] also made observations on the enigmatical *Diatomæ*, in order to decide the question, whether they should be classed with animals or vegetables. On burning a great number of *Fragillaria pectinalis*, an animal smell was noticed. Such a smell would, however, be a very indefinite character, for various other Algæ produce a similar odor on their being burnt to a coal. After the burning of the *Fragillaria pectinalis*, and various other beings of the same kind, Brébisson found siliceous envelops surrounding them in a very perfect state, and precisely similar to those exhibited by the fossil *Diatomæ*, discovered by C. Fischer in the peat-bog near Franzensbad, and which led to those beautiful observations that Ehrenberg made known on this subject in the course of last year.*

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[*] I am sorry to say, that these contradictions must also occur in this year's report, as I do not think Ehrenberg's view as to the animal nature of the *Bacillariæ* weakened by the reasons here stated.—*Wiegmann.*

[†] *Sur les Clostéries, Ann. des Scienc. Nat.*, Vol. I, p. 274.

[‡] The same observation had been made by Corda.—Also by Ehrenberg in 1834.—*Wiegmann.*

[§] Observations sur les Diatomées. L'Institut de 1836, p. 378. Ann. des Scienc. Nat., 1836, II, p. 248.

"The results of those latter observations belong properly to geognosy; but we must add this one remark, that under the fossil Infusoria hitherto discovered, only those beings are to be understood, which botanists, as has been previously shown, receive as plants. The occurrence in a fossil slate of these minute microscopical plants, is caused by the hard siliceous envelop, which resists all destroying influences. Kützing's discovery, that the envelop of the *Bacillariæ* consists of silica, which was mentioned in our first year's report, has, by this circumstance, been rendered more important. If we observe the same minute plants in the living state, it often happens, that amongst them some dead ones occur, which exhibit that perfectly transparent and colorless siliceous envelop; it is therefore proved, that a great mass of such siliceous envelops might also be produced by the *decomposition of the plants, or in the moist way*, and also that the mountain masses, which consist more or less of such siliceous envelops, might not always be regarded as being produced by the action of heat at the bottom of the sea.† Brébisson tries to bring the *Diatomæ* into two divisions, viz. the proper *Diatomæ*, which exhibit a siliceous envelop, and the *Desmidiæ*, which are without a siliceous coating, and entirely reducible to carbon. In the more perfect plants, the epidermis of which is penetrated by a siliceous envelop, it would at least be improper to make such divisions; in this case, however, they may be of some use.

"In a recent memoir, Mohl has again declared himself against the animal nature of the *Bacillariæ*. 'I admit,' says he, 'that the doubt which was raised respecting their vegetable nature is not yet removed; their animal nature, however, has been as little proved, and we find evident transitions from them to vegetables.'"—Lond. and Ed. Phil. Mag., Oct. 1837, p. 385—390.

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* Vide on Fossil Infusoria, Wiegmann's Archiv, 1836, p. 333. A translation of Ehrenberg's two papers on this subject is given entire and with engravings in the Scientific Memoirs, Vol. I, p. 400.—W. F. I have not had an opportunity to see either of these works.—J. W. B.

† Ehrenberg's opinion is, that these masses owe their origin to the action of volcanic heat on the bottom of the sea. Vide Scientific Memoirs, Vol. I, p. 400.

With regard to the question concerning the animal or vegetable nature of the *Bacillariæ*, I can add nothing new to the testimony of those who support their animal nature. I have often witnessed the motions of several species of Bacillariæ, and would no more think of referring them to the action of electricity, than I would the more active, but apparently not more voluntary movements of Vibrio, or Rotatoria. I have seen them advance, and, recede, vibrate to the right and left, push against obstacles, and in case they could not pass them, retreat and go round them. It must be a very curious electric arrangement, that can produce such actions as these.

NOTE.—I have taken considerable pains to distribute specimens of the Fossil Infusoria, &c., above referred to, but those who have not received specimens, and are interested in these matters, may obtain them from Prof. Silliman, to whom I have sent a large supply, from Dr. J. R. Chilton, New York, from O. Mason, Esq., Providence, R. I., and from myself at West Point, N. Y.

### EXPLANATION OF PLATE II.

Fig. 1. One of the fossil Infusoria found at West Point, which appears identical with specimens from Ehrenberg.

Fig. 2. Another species, which is also very abundant in the peat-earth.—N. B. The fine parallel transverse lines are marks upon the shell, which are easily seen with a high magnifying power. The figures represent these objects as magnified about three hundred and fifty times in length.

Fig. 3. A smooth round siliceous body, apparently solid and without any marks. Very abundant in the peat-earth.

Fig. 4. A round solid siliceous body, having numerous asperities. Less abundant than the preceding.

Fig. 5. Siliceous shell of a common species of Infusoria.

Figs. 7, 8, and 9. Siliceous shells of small Infusoria. The motions of the *living* species of Figs. 7 and 8, are more active than those of any of this tribe that I have witnessed. The motions of the species represented by Fig. 5, are also very evident.

Fig. 10. A portion of peat-earth diffused in a drop of water, and moderately magnified (about fifty times.) This shows imperfectly, the immense number, and variety of forms, which exist in the peat-earth.

Fig. 12. *Diatoma flocculosum.* Very common in brooks, &c., among Confervæ.

Fig. 12*a*. an articulation of the same more highly magnified.

Fig. 13. *Diatoma tenue?* Found with the preceding species.

Fig. 13 *a*. An articulation of the same more highly magnified.

Fig. 14. *Diatoma crystallinum?* Straight, smooth, siliceous tubes, occurring in great quantities in small streams, near West Point, closely resembling foreign specimens of D. crystallinum.

Fig. 15. *Fragillaria pectinalis.* *a*, *b*, specimens differing in the width of the articulations. *c*, articulations highly magnified.

Fig. 16. *Meridion vernale?* from Washington's valley, near West Point. *a*, articulations highly magnified.

## ART. X.—*Description of some Experiments made with the Voltaic Battery; by* ANDREW CROSSE, Esq. *of Broomfield, near Taunton, for the purpose of producing Crystals; in the process of which Experiments certain Insects constantly appeared. Communicated in a letter dated Dec.* 27, 1837, *addressed to the Secretary of the London Electrical Society.* Read Jan. 20, 1838.

From the Transactions of the Electrical Society of London.

*My dear Sir*—I trust that the gentlemen who compose the "Electrical Society" will not imagine that because I have so long delayed answering their request, to furnish the Society through you, as its organ, with a full account of my electrical experiments, in which a certain insect made its unexpected appearance, that such delay has been occasioned by any desire of withholding what I have to state, from the Society in particular, or the public at large. I am delighted to find that at last, late, though not the less called for, a body of scientific gentlemen have linked themselves together for the sake of exploring and making public those mysteries, which hitherto, under a variety of names, and ascribed to all causes but the true one, have eluded the grasp of men of research, and served to perplex, perhaps, rather than to afford sufficient data to theorize upon. It is true that much has been done in the course of a few years, and that which has been done only affords the strongest reason for believing that vastly more remains to be done. It would be presumptuous in me to enumerate the services of a Davy, a Faraday, and many other great men at home, or a Volta and an Ampère, with a host of others abroad. These distinguished men have laid the foundations, on which their successors ought to endeavor to erect a building worthy of the scale in which it has been commenced. Electricity is no longer the paltry confined science which it was once fancied to be, making its appearance only from the friction of glass or wax, employed in childish purposes, serving as a trick for the school-boy, or a nostrum for the quack. But it is, even now, though in its infancy, proved to be most intimately connected with all operations in chemistry, with magnetism, with light and caloric; apparently a property belonging to all matter, perhaps ranging through all space, from sun to sun, from planet to planet, and not improbably the secondary cause of every change in the animal, mineral, vegetable, and gaseous systems. It is to determine whether this be or not the case, as far as human faculties can determine, to ascertain what rank in the tree of science electricity is to hold; to endeavor to find out to what useful purposes it might be applied, that I conceive is the object of your Society, and I shall at all times be ready and willing, as a member, to contribute my quota of information to its support, knowing well, that however little it might be, it will be as kindly received as it is humbly offered. It is most unpleasing to my feelings to glance at myself as an individual, but I have met with so much virulence and abuse, so much calumny and misrepresentation, in consequence of the experiments which I am about to detail, and which it seems in this *nineteenth century* a crime to have made, that I must state, not for the sake of myself (for I utterly scorn all such misrepresentations,) but for the sake of truth and the science which I follow, that I am neither an "Atheist," nor a "Materialist," nor a "self imagined creator," but a humble and lowly reverencer of *that* Great Being, whose laws my accusers seem wholly to have lost sight of. More than this, it is my conviction, that science is only valuable as a mean to a greater end. I can assure you, sir, that I attach no particular value to any experiment that I have made; and that my feelings and habits are much more of a retiring than an obtruding character; and I care not if what I have done be entirely overthrown, if truth be elicited. The following is a plain and correct account of the experiments alluded to.

In the course of my endeavors to form artificial minerals by a long continued electric action on fluids holding in solution such substances as were necessary to my purpose, I had recourse to every variety of contrivance which I could think of, so that, on the one hand, I might be enabled to keep up a never-failing electrical current of greater or less intensity or quantity, or both, as the case seemed to require; and on the other hand, that the solutions made use of should be exposed to the electric action in the manner best calculated to effect the object in view. Amongst other contrivanees, I constructed a wooden frame, of about two feet in height, consisting of four legs proceeding from a shelf at the bottom, supporting another at the top, and containing a third in the middle. Each of these shelves was about seven inches square. The upper one was pierced with an aperture, in which was fixed a funnel of Wedgwood ware, within which rested a quart basin on a circular piece of mahogany placed within the funnel. When this basin was filled with a fluid, a strip of flannel wetted with the same, was suspended over the edge of the basin and inside the funnel which, acting as a syphon, conveyed the fluid out of the basin, through the funnel, in successive drops. The middle shelf of the frame was likewise pierced with an aperture, in which was fixed a smaller funnel of glass, which supported a piece of somewhat porous red oxide of iron from Vesuvius, immediately under the dropping of the upper funnel. The stone was kept constantly electrified by means of two platina wires on either side of it, connected with the poles of a Voltaic battery of nineteen pairs of five-inch zinc and copper single plates, in two porcelain troughs, the cells of which were filled at first with water and $\frac{1}{300}$ of hydrochloric acid, but afterwards with water alone. I may here state, that in all my subsequent experiments relative to these insects, I filled the cells of the batteries employed with nothing but common water. The lower shelf merely supported a wide-mouthed bottle, to receive the drops as they fell from the second funnel. When the basin was nearly emptied, the fluid was poured back again from the bottle below into the basin above, without disturbing the position of the stone. It was by mere chance that I selected this volcanic substance, choosing it from its partial porosity; nor do I believe that it had the slightest effect in the production of the insects to be described. The fluid with which I filled the basin was made as follows:

I reduced a piece of black flint to powder, having first exposed it to a red heat and quenched it in water to make it friable. Of this powder I took two ounces, and mixed them intensely with six ounces of carbonate of potassa, exposed them to a strong heat for fifteen minutes in a black lead crucible in an air furnace, and then poured the fused compound on an iron plate, reduced it to powder while still warm, poured boiling water on it, and kept it boiling for some minutes in a sand bath. The greater part of the soluble glass thus fused, was taken up by the water, together with a portion of alumina from the crucible. I should have used one of silver, but had none sufficiently large. To a portion of the silicate of potassa thus fused, I added some boiling water to dilute it, and then slowly added hydrochloric acid to supersaturation. A strange remark was made on this part of the experiment, at the meeting of the British Association at Liverpool, it being then gravely stated, that it was impossible to add an acid to a silicate of potassa without precipitating the silica! This, of course, must be the case, unless the solution be diluted with water. My object in subjecting this fluid to a long-continued electric action, through the intervention of a porous stone, was to form, if possible, crystals of silica at one of the poles of the battery, but I failed in accomplishing this by those means. On the fourteenth* day from the commencement of the experiment, I observed, through a lens, a few small whitish excrescences or nipples projecting from about the middle of the electrified stone, and nearly under the dropping of the fluid above. On the eighteenth* day, these projections enlarged, and seven or eight filaments, each of them longer than the excrescence from which it grew, made their appearance on each of the nipples. On the twenty second* day, these appearances were more elevated and distinct, and on the twenty sixth* day, each figure assumed the form of a perfect insect, standing erect on a few bristles which formed its tail. Till this period I had no notion that these appearances were any other than an incipient mineral formation; but it was not until the twenty eighth day, when I plainly perceived these little creatures move their legs, that I felt any surprise, and I must own that when this took place, I was not a little astonished. I endeavored to detach, with the point of a needle, one or two of them from its position on the stone, but they immediately died, and I was obliged to wait patiently for a few days longer, when they separated themselves from the stone, and moved about at pleasure, although they had been for some time after their birth apparently averse to motion. In the course of a few weeks, about a hundred of them made their appearance on the stone. I observed that at first each of them fixed itself for a considerable time in one spot, appearing, as far as I could judge, to feed by suction; but when a ray of light from the sun was directed upon it, it seemed disturbed, and removed itself to the shaded part of the stone. Out of about a hundred insects, not above five or six were born on the south side of the stone. I examined some of them with the microscope, and observed that the smaller ones appeared to have only six legs, but the larger ones eight. It would be superfluous to attempt a description of these little mites, when so excellent a one has been transmitted from Paris. It seems that they are of the genus *Acarus*, but of a species not hitherto observed. I have had three separate formations of similar insects at different times, from fresh portions of the same fluid, with the same apparatus. As I considered the result of this experiment rather extraordinary, I made some of my friends acquainted with it, amongst whom were some highly scientific gentlemen, and they plainly perceived the insect in various states. I likewise transmitted some of them to one of our most distinguished physiologists in London, and the opinion of this gentleman, as well as of other eminent persons to whom he showed them, coincided with that of the gentlemen of the Academie des Sciences, as to their genus and species. *I have never ventured an opinion as to the cause of their birth*, and for a very good reason—I was unable to form one. The most simple solution of the problem which occurred to me, was, that they arose from ova deposited by insects floating in the atmosphere, and that they might possibly be hatched by the electric action. Still, I could not imagine that an ovum could shoot out filaments, and that those filaments would become bristles; and moreover, I could not detect, on the closest examination, any remains of a shell. Again, we have no right to assume that electric action is necessary to vitality, until such fact shall have been most distinctly proved. I next imagined, as others have done, that they might have originated from the water, and consequently made a close examination of several hundred vessels, filled with the same water as that which held in solution the silicate of potassa, in the same room, which vessels constituted the cells of a large Voltaic battery, used without acid. In none of these vessels could I perceive the trace of an insect of that description. I likewise closely examined the crevices and most dusty parts of the room with no better success. In the course of some months, indeed, these insects so increased, that when they were strong enough to leave their moistened birth-place, they issued out in different directions, I suppose, in quest of food; but they generally huddled together under a card or piece of paper in their neighborhood, as if to avoid light and disturbance. In the course of my experiments upon other matters, I filled a glass basin with a concentrated solution of silicate of potassa without acid, in the middle of which I placed a piece of brick, used in this neighborhood for domestic purposes, and consisting mostly of silica. Two wires of platina connected either end of the brick with the poles of a Voltaic battery of sixty three pairs of plates, each about two inches square. After many months' action, silica in a gelatinous state formed in some quantity round the bottom of the brick, and as the solution evaporated, I replaced it by fresh additions, so that the outside of the glass basin, being constantly wet by repeated overflowings, was, of course, constantly electrified. On this outside, as well as on the edge of the fluid within, I one day perceived the well known whitish excrescence, with its projecting filaments. In the course of time, they increased in number, and as they successively burst into life, the whole table on which the apparatus stood, at last was covered with similar insects, which hid themselves wherever they could find a shelter. Some of them were of different sizes, there being a considerable difference in this respect between the larger and the smaller; and they were plainly perceptible to the naked eye, as they nimbly crawled from one spot to another. I closely examined the table with a lens, but could perceive no such excrescence as that which marks their incipient state, on any part of it. While these effects were taking place in my electrical room, similar formations were making their appearance in another room, distant from the former. I had here placed on a table three Voltaic batteries, unconnected with each other. The first consisted of twenty pairs of two inch plates, between the poles of which I placed a glass cylinder, filled with a concentrated solution of silicate of potassa, in which was suspended a piece of clay slate by two platina wires connected with either pole of the battery. A piece of paper was placed on the top of the cylinder, to keep out the dust. After many months' action, gelatinous silica in various forms was electrically attracted to the slate, which it coated in rather a singular manner, unnecessary here to describe. In the course of time, I observed similar insects, in their incipient state, forming around the edge of the fluid within the jar, which, when perfect, crawled about the inner surface of the paper with great activity. The second battery consisted of twenty pairs of cylinders, each equal to a four inch plate. Between the poles of this, I interposed a series of seven glass cylinders, filled with the following concentrated solutions:—1. Nitrate of copper: 2. Sub-carbonate of potassa: 3. Sulphate of copper: 4. Green sulphate of iron: 5.

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* Denoted by the figs. 14, 18, 22, and 26.

Sulphate of zinc: 6. Water acidified with a minute portion of hydrochloric acid: 7. Water poured on powdered metallic arsenic, resting on a copper cup, connected with the positive pole of the battery. All these cylinders were electrically united together by arcs of sheet copper, so that the same electric current passed through the whole of them.

After many months' action, and consequent formation of certain crystalline matters, which it is not my object here to notice, I observed similar excrescences with those before described at the edge of the fluid in every one of the cylinders, excepting the two which contained the carbonate of potassa, and the metallic arsenic; and in due time a host of insects made their appearance. It was curious to observe the crystallized nitrate and sulphate of copper, which formed by slow evaporation at the edge of the respective solutions, dotted here and there with these hairy excrescences. At the foot of each of the cylinders, I had placed a paper ticket upon the table, and on lifting them up, I found a little colony of insects under each, but no appearance whatever of their having been born under their respective papers, or on any part of the table. The third battery consisted of twenty pairs of cylinders, each equal to a three inch plate. Between the poles of this I interposed likewise a series of six glass cylinders, filled with various solutions, in only one of which I obtained the insect. This contained a concentrated solution of silicate of potassa. A bent iron wire, one fifth of an inch in diameter, in the form of an inverted syphon, was plunged some inches into this solution, and connected it with the positive pole, whilst a small coil of fine silver wire joined it with the negative.

After some months' electrical action, gelatinous silica enveloped both wires, but in much greater quantity at the positive pole; and in about eight months from the commencement of the experiment, on examining these two wires very minutely, by means of a lens, having removed them from the solution for that purpose, I plainly perceived one of these incipient insects upon the gelatinous silica on the silver wire, and about half an inch below the surface of the fluid, when replaced in its original position. In the course of time, more insects made their appearance, till, at last, I counted at once three on the negative and twelve on the positive wire. Some of them were formed on the naked part of the wires, that is, on that part which was partially bare of gelatinous silica: but they were mostly imbedded more or less in the silica, with eight or ten filaments projecting from each beyond the silica. It was perfectly impossible to mistake them, after having made one's self master of their different appearances; and an occasional motion in the filaments of those that had been the longest formed was very perceptible, and observed by many of my visitors, without my having previously noticed the fact to them. Most of these productions took place from half to three quarters of an inch under the surface of the fluid, which, as it evaporated very slowly, I kept to the same level by adding fresh portions. As some of these insects were formed on the inverted part of the syphon-shaped wire, I cannot imagine how they contrived to arrive at the surface, and to extricate themselves from the fluid: yet this they did repeatedly; their old places were vacated, and others were born in new ones. Whether they were in an imperfect state (except just at the commencement of their formation), or in a perfect one, they had all the distinguishing characteristic of bristles projecting from their bodies, which occasioned the French *savans* to remark that they resembled a microscopic porcupine. I must not omit to state, that the room in which these three batteries were acting was kept almost constantly darkened. It was not my intention to make known these observations until I myself should be better informed about the matter. Chance led to the publication of an erroneous account of them, which I was under the necessity of explaining. It is so difficult to arrive at the truth, that mankind would do better to lend their assistance to explore what may be worth investigating, than to endeavor to crush in its bud that which might otherwise expand into a flower. In giving this account, I have merely stated those circumstances regarding the appearance of insects, which I have noticed during my investigations into the formation of mineral matters; I have never studied physiology, and am not aware under what circumstances the birth of this class of insects is usually developed. In my first experiment I had made use of flannel, wood, and a volcanic stone; in the last, none of these substances were present. I never, for a moment, entertained the idea that the electric fluid had animated the organic remains of insects, or fossil eggs, previously existing in the stone or the silica; and have formed no visionary theory which I would travel out of my way to support. I have since repeated these latter experiments in a third room, in which there are now two batteries at work. One consisting of eleven pairs of cylinders, made of four inch plates, between the poles of which is placed a glass cylinder, filled with silicate of potassa, in which is suspended a piece of slate between two wires of platina, as before, and covered loosely with paper. Here, again, is another crop of insects formed. The other battery consists of twenty pairs of cylinders, the electric current of which is passed through six different solutions in glass cylinders, in three of which only is the insect formed, viz. 1st, in nitrate of copper; 2d, in sulphate of copper, in each of which the insect is only produced at the edge of the fluid, as far as I can make out; and 3d, by the old apparatus of coiled silver and iron wire in silicate of potassa, as before. There are now forming on the bottom of this positively electrified wire similar insects, at the distance of fully two inches below the surface of the fluid. On examining these, I have lately noticed a peculiar quality they possess whilst in an incipient state. After being kept some minutes out of the solution, they contract their filaments, so as, in some cases, wholly, and in others partially, to disappear: I at first thought they were destroyed; but, on examining the same spots, on the next day, they were as perceptible as before. In this respect, they seem not unlike the zoophytes, which adhere to the rocks on the sea-shore, and which contract on the approach of a finger. I may likewise remark, that I have not been able to detect their eyes, even when viewed under a powerful microscope, although I once fancied I perceived them. The extreme heat of summer and cold of winter do not appear favorable to their production, which succeeds best, I think, in spring and autumn. As in the above account I have occasionally made use of the word "formation," I beg that it might be understood that I do not mean *creation*, or any thing approaching to it. I am not aware that I have any thing more to add, except the few remarks I shall conclude with.

1st. I have not observed a formation of the insect, except on a moist and electrified surface, or under an electrified fluid. By this *I do not mean to assert that electricity has any thing to do with their birth*, as I have not made a sufficient number of experiments to prove or disprove it; and besides, I have not taken those necessary precautions which present themselves even to an unscientific view. These precautions are not so easy to observe as may at first sight appear. It is, however, my intention to repeat these experiments, by passing a stream of electricity through cylinders filled with various fluids under a glass receiver inverted over mercury, the greatest possible care being taken to shut out extraneous matter. Should there be those who blame me for not having done this before, to such I answer that, independent of a host of other hindrances, which it is not in my power to set aside, I have been closely pursuing a long train of experiments on the formation of crystalline matters by the electric agency, and now different modifications of the Voltaic battery; in which I am so interested, that none but the ardent can conceive what is not in my power to describe.

2dly. These insects do not appear to have originated from others similar to themselves, as they are formed in all cases with access of moisture, and in some cases two inches below the surface of the fluid in which they are born; and if a full grown and perfect insect be let fall into any fluid, it is infallibly drowned.

3dly. I believe they live for many weeks: occasionally I *have* found them dead in groups, apparently from want of food.

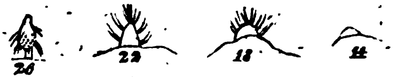
4thly. It has been frequently suggested to me to repeat these experiments without using the electric agency; but this would be by no means satisfactory, let the event be what it would. It is well known that saline matters are easily crystallized without subjecting them to the electric action; but it by no means follows that, because artificial electricity is not applied, such crystals are formed without the electric influence. I have made so many experiments on electrical crystallization, that I am firmly convinced in my own mind, that electric attraction is the cause of the formation of every crystal, whether artificial electricity be applied or not. I am, however, well aware of the difficulty of getting at the truth in these matters, and of separating cause from effect. It has often occurred to me, how it is that such numbers of animalcules are produced in flour and water, in pepper and water? also, the insects which infest fruit trees after a blight? Does not a chemical change take place in the water, and likewise in the sap of the tree *previous* to the appearance of these insects, and is or is not every chemical change produced by electric agency? In making these observations I seek to mislead no one. The book of nature is opened wide to our view by the Almighty power, and we must endeavor, as far as our feeble faculties will permit, to make a good use of it; always remembering, that however the timid may shrink from investigation, the more completely the secrets of nature are laid bare, the more effectually will the power of that Great Being be manifested, who seems to have ordained, that

"Order is Heaven's first law."

I beg to remain, in the mean time, my dear Sir,
Yours, very sincerely,
ANDREW CROSSE.

Broomfield, Dec. 27, 1837.

P. S. Since writing the above account, I have obtained the insects on a bare platina wire plunged into fluo-silicic acid, *one inch below* the surface of the fluid at the negative pole of a small battery of two inch plates in cells filled with water. This is a somewhat singular fluid for these insects to breed in, who seem to have a flinty taste, although they are by no means confined to siliceous fluids. This fluo-silicic acid was procured from London some time since, and consequently made of London water; so that the idea of their being natives of the Broomfield water is quite set aside by this result. The apparatus was arranged as follows: Fig. 7, a glass basin (a pint one) partly filled with fluo-silicic acid to the level 1. 2, a small porous pan, made of the same materials as a garden pot, partly filled with the same acid to the level 2; with an earthen cover, 3, placed upon it, to keep out the light, dust, &c. 4, a platina wire connected with the positive pole of the battery, with the other end plunged into the acid in the pan, and twisted round a piece of common quartz; on which quartz, after many months' action, are forming singularly beautiful and perfectly formed crystals of a transparent substance, not yet analyzed, as they are still growing. These crystals are of the modification of the cube, and are of twelve or fourteen sides. The platina wire passes under the cover of the pan. 5, a platina wire connected with the negative pole of the same battery, with the other end dipping into the basin, an inch or two below the fluid; and, as well as the other, twisted round a piece of quartz. By this arrangement it is evident that the electric fluid enters the porous pan by the wire 4, percolates the pan, and passes out by the wire 5. It is now upwards of six or eight months (I cannot at this moment put my hand on the memorandum of the date) since this apparatus has been in action, and though I have occasionally lifted out the wires to examine them by a lens, yet it was not till the other day that I perceived any insect, and there are now three of the same insects, in their incipient state, appearing on the naked platina wire at the bottom of the quartz *in the glass basin at the negative pole.* These insects are very perceptible and may be represented thus (magnified): fig. 8, 1 the platina wire, 2 the quartz, 3 the incipient insects. It should be observed that the glass basin, fig. 7, has always been loosely covered with paper. The incipient appearance of the insect has already been described. The filaments which project are in course of time seen to move, before the perfect insect detaches itself from its birth-place.



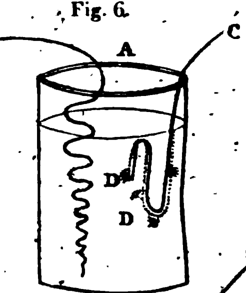


Fig. 6.

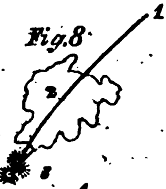


Fig. 8.

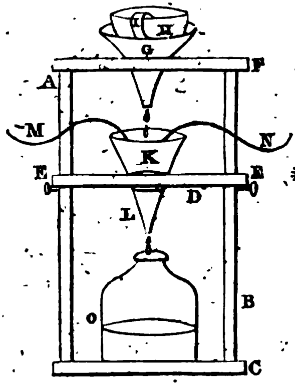


Fig. 5.

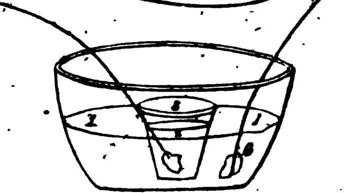


Fig. 7.

Fig. 5, front view of the filtering apparatus, by the use of which, the insect described made its first appearance. (A, B,) two of the four uprights or legs issuing from the base (C,) supporting a movable shelf (D;) which shelf is kept in its place by four pins (E) passing through the four uprights, and may be raised or lowered at pleasure. (F,) the top shelf, which has an aperture cut in it to receive the Wedgwood ware funnel (G.) (H,) a quart basin standing on an unseen support within the funnel (G,) which support is a circular piece of wood with holes cut in it to allow the free passage of the fluid between the basin and funnel. This basin is filled with the fluid required, which is conveyed out of it by the strip of flannel (I,) hanging over the outside of the basin, and inside the funnel, and which, consequently, falls in successive drops through the funnel (G) upon the stone (K,) which is supported by the glass funnel (L,) kept constantly electrified by the two platina wires (M, N,) resting on the opposite sides of it, and connected with the opposite poles of a voltaic battery. (O,) a wide mouthed bottle standing on the base (C,) to receive the fluid as it falls from the second funnel (L.) From this bottle, when required, it is poured back again into the basin (H) without disturbing the stone (K.)

Fig. 6, (A,) a glass cylindrical vessel, containing about a quarter of a pint, filled with a concentrated solution of silicate of potash. (B,) a fine silver wire formed into a coil, which is immersed into the fluid in the cylinder, the other end being connected with the negative pole of the battery. (C,) an iron wire about one fifth of an inch in diameter, bent somewhat in the form of an inverted syphon, immersed in the same vessel, and connected with the positive pole of the battery. (D, D) insects in their incipient state making their appearance, some on the gelatinous silica which partially covers the wire, and some on the naked wire itself. These insects appear magnified.

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## ART. XI.—*Notice of Danburite, a new Mineral Species;* by CHARLES UPHAM SHEPARD, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

THE mineral here described, I found upwards of two years ago, while engaged in the geological survey of Connecticut. It was collected in the town of Danbury near the manufactory of Col. WHITE, and occurred in small masses of a delicate bluish white and highly crystalline feldspar, found among fragments of dolomite, coming from a bed in place near the mills. The feldspar is extremely fetid, when rubbed or broken: in which respect it resembles the same mineral found in thin veins of dolomite at a locality a few miles distant, in the town of Brookfield,—a circumstance which leaves little room to doubt that the specimens at Danbury, though found detached, were nevertheless derived from the dolomite.

The mineral believed to be new is observed disseminated in small quantity through the feldspar (with which is likewise associated a small quantity of quartz) in fissures and cavities having the shape apparently of oblique prisms. Owing to the partial decomposition of the mineral (a change to which it appears to be particularly liable) these cavities are sometimes entirely empty. The longest of them noticed was above an inch in one direction, by one fifth of an inch in another.

Whether the mineral will be found in any considerable quantity, I am unable to say. The specimens collected, have been barely sufficient to afford the following notice.

## *Mineralogical Description.*

Primary form. Oblique rhombic prism.

Cleavage parallel with P indicated obscurely by fissures.

Lustre vitreous, in a high degree. Color shades of honey yellow. Streak white; transparent. (The decomposing variety is nearly white, translucent and very fissile.)

Hardness=7.5. Sp. Gr.=2.83.

## *Chemical Description.*

When heated alone before the blow-pipe, it phosphoresces and fuses slowly without intumescence into a white blebby, transparent glass. With borax, it melts with effervescence into a transparent globule. When heated in a glass tube, it emits moisture. In the condition of an impalpable powder, it is taken up by hydro-chloric acid after long digestion.

By the requisite trials, it was found to contain neither fluoric, boric, nor phosphoric acid. By heating, it lost 8 p. c. in weight. By ignition with twice its weight of anhydrous carbonate of soda, it fused into a white mass, which formed a colorless solution with dilute hydro-chloric acid. After the separation of the silica, which weighed 56 p. c., the solution was precipitated by ammonia, and the precipitate treated with carbonate of ammonia solution in large excess, which after frequent agitation and some time standing was partially evaporated; a pale yellow pellicle invested the sides of the capsule, which after drying weighed 0.85 p. c. It was treated with hydro-chloric acid, and the solution obtained afforded when tasted no impression of sweetness. Its yellowish color and easy solubility after ignition in hydro-chloric acid proved it not to be zirconia; while the absence of sweetness showed that it was not glucina. It seems most probable therefore, that it is yttria.

The portion of the precipitate by ammonia not taken up by the carbonate of ammonia, was treated with a solution of potassa. It was instantly dissolved, and on being precipitated with hydrochlorate of ammonia, washed and ignited, it amounted to 1.7 p. c.

The clear hydro-chloric solution from which the alumina and yttria? had been separated was precipitated by oxalate of ammonia, and the precipitate was washed and ignited. The residuum gave 28.33 p. c. of lime.

The solution from which the oxalate of lime had been thrown down was treated with ammonia and phosphate of soda, without having its transparency effected, whereby the absence of magnesia and lithia in the mineral was apparent. After several hours standing, chloride of platina was added, which immediately gave rise to the fine granular precipitate of the double salt of platino-chloride of potassium.

Whether the mineral contains soda as well as potassa, I am not at present able to say.

The following therefore is a summary of what I have been able to infer respecting the chemical constitution of the mineral under consideration:

| | |
|---|---|
| Silica, - - - - | 56.00 |
| Lime, - - - - | 28.33 |
| Alumina, - - - - | 1.70 |
| Yttria? - - - - | 0.85 |
| Potassa (perhaps with soda) and loss, | 5.12 |
| Water, - - - - | 8.00 |
| | 100. |

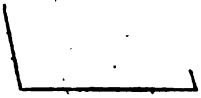
The above result favors the idea of the following atomic arrangement: viz.

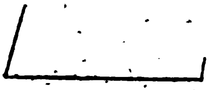
$$10\,\dot{C}a\,Si^3+\dot{K}^3+\left(\frac{2}{3}\,\underline{\dddot{Al}}+\frac{1}{3}\dot{Y}\right)Si^3+\dot{H}.$$

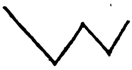
## Art. XII.—*On Certain Cavities in Quartz, &c., in a letter to the Editor, from* Dr. Washington L. Atlee, dated Lancaster, Penn., Dec. 9, 1837.

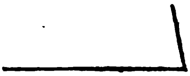
*Dear Sir*—Within our city and its vicinity I have picked up several anomalous specimens of quartz, bearing the impressions of the different faces and angles of crystals, that afterwards became detached. In most of these specimens these impressions are deep, giving a cellular aspect to the whole mass. In some, they are tabular and evidently rhombic, or portions of rhombs, having their various angles and inclined faces accurately defined. In others, the indentations are principally pyramidal and cuneiform, with here and there a tabular rhombic impression. In one large and beautiful specimen, the cells are much larger, and more uniformly rhombic, than in any other that I have seen. The general figure of this specimen is oblong. It is compressed upon two opposite surfaces, and possesses additional interest by having two translucent crystallized surfaces capping the one end. These faces incline at an angle of about 120°, are 8 inches long, and 3$\frac{3}{8}$ wide, having a ragged periphery, as if broken, and constituting two of the planes of an hexagonal prism. Another smaller specimen has two sides of the prism and two sides of the pyramid extending across the centre of the mass; while a third is completely surrounded by innumerable cells, with acicular crystals of actynolite pervading one end.

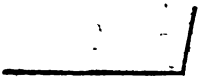
In order to ascertain the particular angles of these cavities, several casts were made for me by my friend Dr. E. Parry. Taking these as correct models of the crystals that preoccupied these cavities, it will be easy to ascertain their exact figure. The following diagrams will represent the angles of several of the casts, viz.

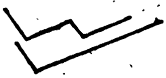






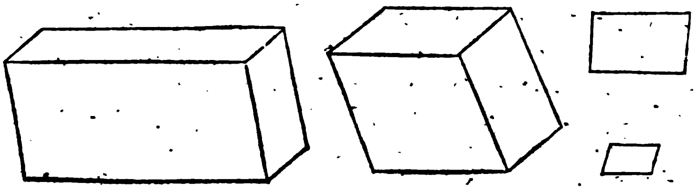






These angular and tabular impressions vary in size from the smallest pyramidal point and rhombic table, to rhombic cavities of three inches parallel diameter, and two inches in depth. And you will perceive that the above diagrams are all portions of rhombic figures.

A geological inquiry naturally arises as to the cause of the peculiar cellular structure of these specimens. Before inquiring into the particular agents which prepared the quartz to receive these impressions, and caused the dispersion of the crystals that produced them, it will be necessary to examine into the character of the solids, which, at one time, were encased by these peculiar cavities. Your attention has been called above to the rhombic form of the casts. Now there are no mineralogical specimens, of a rhombic character, occurring in our vicinity, that so exactly correspond with these casts as those of calcareous spar. This is not only proved by goniometrical measurement, but also by placing a crystal of this spar into one of these depressions; the faces and angles of both come into exact apposition. This will be apparent to you by making a drawing of a few crystals indiscriminately taken up, viz.



This form of carbonate of lime is of very frequent occurrence in our neighborhood, and crystals, varying in size, are aggregated together in masses corresponding to the cellular character of these specimens. Still, in no specimen, have I been able to trace within these cavities any of the remains of carbonate of lime. In other specimens of cellular quartz, occurring in our vicinity, where the cavities are formed by the disintegration of cubic and amorphous pyrites, the remains of the sulphuret are quite evident. Would it not, however, be fair to infer, from the exact correspondence of the former with the latter, even though no portion of the former remained, that the crystals of calcareous spar caused these cavities? Assuming this inference as correct, we can now pursue the inquiry further.

In investigating the cause of this phenomenon, there are two agents, water and heat, to which I shall confine my remarks; and as fluidity must have been essential to formations of such peculiar character, it will be necessary first to ascertain what natural operation could have contributed to it. We have only to notice the frequent occurrence of siliceous stalactites, the large beds of porcelain clay formed by the disintegration and decomposition of granite, animal and vegetable petrifactions, the formation of agates and other minerals in the cavities of basaltic and trappean rocks, the constitution of sandstone, and many other instances, to be convinced of the fact that water frequently holds silex in solution or suspension, and conducts it, by percolation, to faults, dislocations, or crevices, where, becoming again precipitated, it gradually consolidates into some regular mineralogical form, or moulds itself to the particular contour and around the projecting points of the cavity. The action of water, therefore, is capable of reducing quartz to a fluid and plastic state.

The occurrence of calcareous spar is most frequent in veins, cavities, or fissures, associated with quartz and other minerals. Its formation is likewise dependent upon the filtration of water, holding carbonate of lime in solution, which assumes its crystalline character from the slow percolation or evaporation of the water. Water, therefore, saturated with siliceous particles, in its progress through the earth, will get access to cavities lined with calcareous spar, and here gradually precipitate them. These particles will regularly accumulate, and as the water which conveyed them there filters out, they will condense more and more, and ultimately consolidate around the projections and within the angular sinuosities of the uneven surface of this mass of aggregated crystals. The quartz, thus becoming plastic, will mould itself to the spar, and this afterwards becoming dissipated by agents incapable of acting on the quartz, will leave its impressions accurately defined, and communicate to these specimens their peculiar character.

The question regarding the separation of the carbonate of lime from the quartz next arises; and the agent most likely to accomplish this without impairing the integrity of the quartz or forming a new and insoluble compound in the cavities, I conceive is water. Although water itself is not a good solvent of carbonate of lime, yet, when charged with carbonic acid, its power is much increased. Now, it is well known that there are many local sources of carbonic acid gas, and even in our own county, it is frequently found collected in large quantities in the bottoms of wells. That this gas, always generating by some subterranean process, combines readily with water in its vicinity, is evidenced by the frequent occurrence of carbonated springs: and as the absorbent power of the water is increased in a direct ratio with the pressure, so is its solvent power augmented in proportion to the accumulation of carbonic acid. Carbonic acid gas, therefore, confined within cavities beneath the surface of the earth, must necessarily be exposed to considerable pressure, and under these circumstances will be copiously absorbed by water in contact with it. Water, thus impregnated, being conveyed to the mass of crystals imbedded within the quartz, will effectually dissolve it and wash it out from the cavities it formed, without in the least affecting the conformation of the quartz.

It is in this way that I conceive the production of these cellular specimens may depend upon the agency of water; but, as their formation may be attributed, perhaps with equal propriety, to the action of heat, I am disposed to carry the investigation a little further.

Nearly all modern geologists and chemists have given their consent to the existence of central heat, as indicated by the increase of temperature as we descend into the earth, by the heat of the water of the Artesian wells, by the occurrence of thermal springs, the existence of active volcanoes, and other familiar facts. That this central heat is very intense, may be inferred from the fused condition of volcanic productions, and yet it is questionable whether these productions are exposed to the maximum of heat. The volume and chemical character of lava would indicate volcanic heat to be equally as great, if not much greater than that of the compound blowpipe, and yet we have seen, from the experiments of yourself and Dr. Hare, that the power of the latter will fuse silex with ease and rapidity, and Lavoisier effected this with oxygen gas on burning charcoal. Now, as veins or beds of quartz are usually situated in primitive rocks, it must necessarily have been exposed to the most powerful action of central heat in order to occupy its present situation.* If, therefore, the cavities of these veins and fissures were pre-occupied and lined by crystals of calcareous spar, we can easily conceive how the injection of this siliceous fluid would cover and fill the angular points and depressions of the rhombic crystals, and by subsequent and gradual refrigeration the consolidation of the quartz would be effected, and one as it were be dove-tailed into the other. The heat, also, necessary to the fluidity of the quartz, would be more than sufficient to expel the carbonic acid from the spar, and as this would not affect its crystalline conformation before the quartz would solidify, the cellular peculiarity of the latter would not of course in any wise be modified. After these parts had sufficiently cooled, water gaining access to them, and coming in contact with the decarbonated lime, would cause it to *slacken*, thus producing perfect disintegration; and by the continuation of the supply of water, the hydrate of lime thus formed would be washed out of the cavities in the quartz. So that the same heat which rendered the quartz plastic enough to assume this form, prepared the calcareous spar for its disintegration by reducing it to *quicklime*, between which and water a new chemical combination occurs, which effects its final dissipation, and leaves the specimen as we find it, free from any traces of carbonate of lime, except the mere correspondence of the crystals of the latter with the cavities of the former.

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* The igneous origin of these veins may, perhaps, be too positively inferred, as it is conceivable that they could be effected by infiltration.

The crystallized hexagonal surfaces of two of the specimens can be explained by either the agency of heat or water, as crystallization from solution can be artificially effected by evaporation, and afterwards can be again liquefied by heat, and re-crystallized by gradual cooling. Yet the specimen containing actynolite would indicate an igneous origin.

Whether the formation of these specimens can be attributed to either of the above causes, or to both, or to neither of them, and at what particular geological period they may have occurred my knowledge is too limited positively to determine. Their consideration, too, may be more curious than useful, yet as they have not received any attention from the authors in my possession, I have taken it for granted that the specimens are rare, and that their history might be a slight contribution to science. These motives have induced me to forward you an account of them, with my hasty views of their production, believing, too, that if they possessed real interest my communication would not be unwelcome, and that if they do not, no harm could result.

P. S. There is a communication on Spontaneous Combustion in Vol. XXXIII of your Journal, by Dr. James Mease, and among other instances is one taken from Hazard's Register of Pennsylvania, of a piece of wood taking fire in the store of Mr. Adam Reigart of our city. This statement differs from that made to me by Mr. Reigart and his clerk, Mr. G. H. Whitaker. The wood was *chestnut*, quite solid, about eight inches long, and three or four wide, and cut smooth with a penknife. Two days before the burned wood was observed, they had *washed* the shelf and handled the wood with *wet* hands. When first noticed *it was not then on fire*, but the most of it had been reduced to ashes. The unconsumed portion was ragged and perforated,* and what is remarkable, not in the least *charred*, while the *paint* on the shelf on which it lay was destroyed as by fire. Mr. Whitaker still had a portion of the wood and ashes, which he presented to me.

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* Probably the combustion only took place at the points which had previously been wet.

## **Art. XIII.**—*On the Atmospheric Origin of the Aurora and its Connexion with the Crystallization of Snow;* by B. F. Joslin, M. D., of the city of New York, and late Professor of Natural Philosophy, &c. in Union College, Schenectady.

New York, 122 Bleecker street, Aug. 17th, 1838.

TO PROF. SILLIMAN.

*Dear Sir,*—There appears to be increasing evidence of an intimate connexion between the aurora and atmospheric vapor, a connexion which has not been wholly overlooked by recent observers. Recent epochs may have been more favorable to its exhibition in the middle latitudes. In the two brief notices of the aurora in the Transactions of the British Association, which met in August, 1837, this is the most prominent feature. In one, Dr. Traill describes the contemporaneous exhibition of stationary cirri and auroral streamers, and, in the other, Mr. Herapath attempts to refer the aurora to the precipitation of aqueous vapor. Still earlier, in your own respectable Journal, in a notice of my theory, published in 1836, there was an implied acknowledgment of the existence of some kind of auroral vapor, and even of its magnetic properties.

In March, 1836, there were published Observations on fifty six Auroras, seen by me at Schenectady, N. Y., within the five preceding years, and some new views as to the connexion between this meteor and clouds, rain and snow.*

The author desires to avail himself of the wider circulation of the Journal of Science to communicate to the public some of the principal results, to add others in confirmation of the same views, and to correct a misapprehension which may prevail in relation to the elevation which he assigns to this meteor.† The small elevation which he is supposed to have assigned it is the only objection which he has seen made to his views.

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* Vide Appendix No. 2, to the Report of the Regents of the University of the State of New York, and the same in a pamphlet of sixty nine pages, entitled "Meteorological Observations and Essays."

† For the sake of convenience, the term meteor will be used in its more comprehensive sense.

Below is a passage from the paper above referred to, and relates to its different classes of facts, propositions and speculations. It may show that the author has not confounded their different degrees of evidence.

'The present article not having been commenced with reference to any comprehensive theory, presents some miscellaneous facts, which are thrown into the common stock for the use of others. Even among the relevant facts, there are, undoubtedly, interesting relations yet to be traced. 2d. The article contains some generalizations, whose results, whilst they may suggest to others a more correct theory, cannot be thereby invalidated. 3d. There are inferences of another class which may be modified, but probably not overthrown by the progress of discovery. For example, that the aurora is an electrical phenomenon; that it is intimately connected with the elements of clouds, and with these elements only when they are generated in air intensely cold as well as nearly saturated; and that cirrus clouds of a certain class are intimately connected with auroral action, and that both these phenomena, and also coronæ, do, for some reason or other, require a cold adequate to the crystallization of aqueous vapor, are propositions which will not lose all their interest nor any of their truth, even if the discovery should be made that the elements of clouds are essentially globular or vesicular, and that the vapor is not yet crystallized at the time of the phenomenon. It may be necessary to remark, that we have not intimated that all snow is not crystallized. On this subject crude notions have prevailed. 4th. As to the views which belong to a more hypothetical class, the author will cheerfully renounce them when a more plausible theory shall appear, as they are designed to facilitate, not to limit, investigation. This theory may contain much that is novel, valuable and true, without being in the highest sense *the* truth.'

The individual facts on which the generalizations are founded, cannot be here repeated. Of the second class, or the generalizations, are the following

### '*Propositions,*

*Which may be regarded as approximately and generally true,* in relation to mean results, though not universally, or in relation to each particular instance.

Proposition 1st, in relation to the *relative time of greatest depression of temperature before different meteors.*

The greatest daily depression or decrement of temperature takes place between one and two days previous to the aurora borealis, auroral clouds and halos.*

Proposition 2d. *Relative order of the thermometric and barometric changes before different meteors.*

Previous to the clouds and halos, the temperature changes either earlier than the pressure or nearly at the same time; previous to the aurora, the pressure changes more than one fifth of a day before the temperature.*

Proposition 3d. *Length of time before the storm† when its indications appear in case of different meteors.*

When the snow or rain is preceded by an aurora borealis or by luminous columns, the thermometer begins to fall and the barometer to rise between three and five days before the storm; and when the storm is preceded by auroral clouds or halos the same indications are presented between three and three and a half days before it.

Proposition 4th. *Increase of pressure before rain or snow not preceded by these meteors.*

Previous to a thunder shower, or a rain or snow not preceded by an aurora borealis, a halo, or auroral clouds or luminous columns, the increase of atmospheric pressure for several successive days is less general; but when it does occur, it commences either earlier or later than when the storm is preceded by either of those meteors; more generally between five and a half and six days before the shower or storm.

Proposition 5th. *Time from different meteors to snow or rain.*

The snow or rain descends sooner after a halo than after an auroral cirrus cloud, earlier after this than after a vertical lunar column, and earlier after a lunar column than after an aurora borealis.

Proposition 6th. *Theoretical inference in relation to the nature of these meteors.*

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* These propositions now stand nearly as they were corrected in the list of errata in many Nos.

† I use the term storm from the want of a better one equally brief, to signify the descent of rain, snow, or hail.

As they are all preceded by a depression of atmospheric temperature below the mean, and by an augmentation of pressure greater than that which precedes the fall of snow or rain at times when none of these meteors have recently appeared, there is additional evidence of the similarity of their origin.

Proposition 7th. *Theoretical inference in relation to their altitude.*

We may infer from the last two propositions that a magnetic cirrous cloud is higher than a halo, but lower than a lunar column, and the latter lower than the aurora borealis.

Proposition 8th. *Practical inference with regard to the prognostication of storms.*

The foregoing propositions which relate to pressure and temperature may suggest a rule for predicting storms much earlier than by other methods; inasmuch as these changes, and especially that of the barometer, take place even more generally than those opposite changes which often occur within the twenty four hours immediately preceding the storm, and which have been observed by others, and generally regarded as among the surest indications.'

The above propositions are deduced from tables here omitted, and are founded upon the observation of forty auroras, twenty two auroral clouds, seen in the day time, seventeen halos, and four luminous columns. The propositions in relation to the last and more rare phenomenon, the author considered as entitled to less confidence on account of the small number observed. Yet the optical theory which he gave of it in which he attributes it to a mixture of horizontal, specularly-reflecting, crystalline plates, with masses which are more amorphous and which produce a reflection virtually radiant, he considers as complete and satisfactory, and corroborated by his observations on the crystals which subsequently descended. The author has observed the aurora in connexion with the above and other meteorological phenomena of the same, the preceding and the succeeding days, and endeavored to trace their respective and relative changes, and as far as the subject admitted, by the statistical and numerical method. This is a fertile field, and comparatively unoccupied.

In the 3d, or class of inferences, he has endeavored to show a *connexion between the aurora borealis and the crystallization of snow.*

The following is a summary.

'That crystals of snow more minute and simple than those which occasion halos, and usually too minute to produce sensible opacity, are always present in the atmosphere, above the region of ordinary clouds, during the time of this meteor, we are induced to believe from a comparison of the results of the foregoing observations. Several of these results are believed to be new. The following are some of the circumstances which have a bearing upon this question.

1st. Those seasons of the year and those hours of the night when it most frequently occurs, are favorable both to the presence and congelation of aqueous vapor in the atmosphere.

2d. The clearness of the sky, which at such times is usually either general or total.

3d. The usual northerly breeze at the earth's surface, and the northeasterly breeze in the high region of the meteor.

4th. The usual depression of the temperature, at those heights at which thermometrical observations are made.

5th. The clouds which usually succeed the meteor immediately or on the same evening, and which often present the appearance of being continuous and identical with the auroral matter.

6th. The snow that in weather sufficiently cold, almost universally follows the meteor, after such an interval as the simple crystals might be expected to require for aggregation in more complicated groups and descent to the earth's surface.

7th. The rain that almost universally succeeds it, after about the same interval, whenever the temperature of the lower atmospheric strata is sufficient to melt falling snow.

8th. The co-existence of halos with regular crystals, the connexion between halos and auroral clouds, and between auroral clouds and vertical lunar columns, and the analogy between auroral clouds and the aurora borealis.

9th. The pinnate appearance of composite auroral clouds, which appear (so to speak) like large crystals.'

From this point, the author, not finding any former theory of the aurora not liable to great objections, has ventured into the regions of speculation, and in relation to the intimate nature of the phenomenon, and under the 4th head, of views of a more hypothetic class, has ventured to inquire whether atmospheric crystallizations may not occasion the development of auroral light, and the crystals be, under some circumstances, magnetic; and in relation to the 9th remark, has inquired, 'May not this expression be used as something more than a figure of speech? What is so likely to produce this structure, so regular, and yet so complicated, as the polarity of component crystals, whether this polarity is or is not magnetic? May not the ponderable material of the colonnade of an aurora borealis consist of similar groups of crystals, formed either from the vapor of water, or from some lighter, less condensible and more magnetizable vapor in the upper regions, which crystallizes at the same time, and under similar meteorological influences with the former?' Has not the crystalline character of the higher clouds, if it exists, been generally overlooked by meteorologists; and when they have represented all clouds as being masses of condensed vapor, and snow as resulting from its subsequent congelation, have they not overlooked the universally crystalline character of snow, forgotten the small height which is necessary for crystallization, and suffered their imaginations to be influenced by their own temperate climes and moderate elevations?

In advancing a step farther in the attempt at an explanation of the intimate nature of the phenomenon, and especially as connected with aqueous crystals, the author has ventured with diffidence upon a topic still more recondite and obscure, but has found some support in analogies drawn from the electrical light seen during the crystallization of water, from the induction of crystals, and the magnetism developed by changes of temperature in many crystalline substances ordinarily unmagnetic. That iron, probably from its magnetic properties, has a peculiar relation to the crystals of hoar frost, he has been led to suspect, from their tendency to assume a position at right angles to the edges of a magnet and of a tinned vessel, at temperatures between zero and – 12°.

'In experiments with the solar microscope, I have been struck with the analogy between the polarity of crystals and that of magnets, a polarity evinced by the rotation of the smaller groups, in their approach to the larger and more complicated ones. The extent of rotation produced in one group by another never exceeded 180°. I have also detected a still more interesting analogy in the influence which a large group exerts upon the formation of smaller ones at a considerable distance. There was a real *induction*. This was evident from the fact that a large nucleus spread more rapidly than a small one, advancing like a wave, overtaking and absorbing those waves which had begun to spread from a smaller nucleus. This induction, or the influence of a crystalline mass, in disposing particles and small crystals which are in its vicinity, but at some visible distance from it, to unite *with each other*, was still more evident from observing on the screen the existence and motions of scattered clusters composing a darkly dotted border or penumbra, skirting the darker image of the general crystalline mass already formed, and regularly advancing before it across the screen. Perhaps we should hardly be justified in calling such phenomena magnetic; yet it would be easy to show that these and many other phenomena exhibited by microscopic crystals, are regulated by laws strikingly analogous to those of magnetic induction.'

The above phenomena may be shown with great distinctness in tincture of camphor, sufficiently diluted to make the process slow.

If the electricity of crystallizing water is ever connected with magnetism, it must be during the perfect crystallization in the elevated regions of auroral action, where the circumstances are favorable to the perfection both of the process and the products. The rarity of the vapor there is favorable to a regular aggregation of the molecules, and the cold is intense. During crystallization, the temperature of the crystal might rise to 32°, by the evolution of latent heat, and soon afterwards sinking perhaps 100°, to the original temperature of the vapor. For such immense and instantaneous changes, a less elevation in the air is requisite in the higher latitudes; and there, it appears from observation, that the aurora itself is less elevated. It is unnecessary to cite the numerous authorities which exist, to prove the occasional lowness of the aurora in high latitudes. Mr. Trevelyan observed, that in Faroe and the Shetland islands, it was often seen not more than forty or fifty feet above the sea, and learned, that in both countries it is frequently heard. One person had perceived in it, when red, an electrical smell.*

In our latitude, the aurora is usually at great heights. On this subject the author's views seem to have been misapprehended. Some of the intimate connections which he has proved to exist, as well as others which he has believed to exist, between the aurora and a certain class of clouds seen in the day time, do not imply an usual identity of location. He had stated, that the aurora is usually higher than clouds, even than cirrous clouds, which are often many miles above other clouds, and many miles above the highest mountains. It by no means follows, that its origin is above crystals of the invisible kind. That the latter may be forming and descending for many hours, and in some instances a day, before they attain such a number, magnitude and complexity, as to form visible haze, is evident from the phenomena of halos and vertical solar and lunar columns in a clear sky. But these crystals, in their nascent state, must have had a still earlier and higher existence. Should it then be thought surprising, that minute crystals, in a region far above halos, should require a day longer for their aggregation and descent?

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* Edinb. Philos. Jour. vii, 182.

It is not my present purpose to discuss at length the question as to the intimate nature of the aurora; but I am of opinion that in some region, usually high, a crystallization takes place on the evening of an aurora, and that the latter originates in the atmosphere. In the publication above referred to, I have ventured to speak of such a thing as "atmospheric magnetism," and to regard it as the direct cause of the needle's disturbance, and as located in a kind of auroral vapor; although it was the prevalent opinion of philosophers, that the aurora, so far as it was magnetic, was connected with changes in tellurian magnetism alone, that is, the magnetism of the solid earth. The variations of the needle were thought to afford evidence of variations in the latter; and this view was thought to be corroborated by some simultaneous disturbances of the needle in distant parts of the globe. Numerous facts might be cited, in corroboration of the atmospheric location. Let one at present suffice. During the brilliant and extensive red aurora of Jan. 25, 1837, I observed at Schenectady, N. Y., a variation of the needle of 1½° in eighteen minutes, of 2¼° in two hours, and 2½° during the night. At New Haven, the variations were, at one hour, still more rapid, that is, 45′ in two minutes; but the whole extent observed was only 1°. About thirty miles north of New Haven, no change whatever could be detected; whilst at Annapolis, the needle varied to the astonishing amount of 10° during the night.* Are not these facts wholly irreconcilable with the idea, that the needle was disturbed by a general change in the magnetism of the earth? According to Capt. Back, auroral beams sometimes seem to attract each other. Does not this seem like atmospheric magnetism?

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* See this Journal, Vol. xxxii, p. 180.

There appears to be no reason to believe that the aurora is at an invariable elevation. Calculations founded on observed altitudes, have given results varying from a few miles to several hundred. This discrepancy may be explained, partly by an actual difference of height, and partly by mistakes as to the identity of arches when several have been presented to different observers. In the latter case, a mistake will usually lead to an exaggeration, rather than to an underrating of the elevation. Suppose two observers, near the same meridian, but in different latitudes, to take the altitudes of two arches situated north of their respective observers, and at so small an elevation, that the southern arch is below the horizon of the northern observer, and the northern arch below the horizon of the southern observer. Only one being seen by each, they are liable to be presumed identical; and the great altitude of the northern as compared with the southern arch, would lead the mathematician to refer the imaginary arch—considered as one—to an elevation greater than the actual elevation of either of the real arches. There is evidence that the above case is more than a supposable one, and that similar mistakes have actually occurred. The opposite error, an exaggeration of the parallax, would, from the nature of the case, more rarely occur. I have stated the first in a plain way, that those who are little conversant with the subject may not be deterred from examining the physical evidence of a theory of the aurora, by a caveat supposed to have been entered by the exact sciences. There are facts quite as conclusive as a great parallax: such as the numerous instances where individuals at moderate distances cannot recognize the same phases, and some of them not even the existence of the aurora seen by the others. In such cases, it may fail to be measured, simply because it is too low.

The views which I have taken of the aurora, whilst they do not require us to discredit those numerous proofs, both physical and mathematical, of its occasional situation in the inferior atmospheric strata, at the same time, allow, or even require us to refer it in most instances to elevations above (and in the lower latitudes far above) the regions of the highest proper clouds, and many times as high as ordinary clouds. Physical considerations have induced me to refer its origin to the earth's atmosphere. The height of this is well known never to have been determined, so far as respects those rarer portions which reflect no sensible light.

Those who reflect, that there is a depression of about 1° for every 300 feet of elevation, will find little difficulty in admitting the existence of crystals of snow above us in summer. The following facts have a bearing on this, as well as on the connection between the aurora, snow, and magnetism. "On the 16th of August, 1836, I observed, at Schenectady, an aurora, at 10 P. M., chiefly obscured by clouds, and a faint aurora with three or four short streamers extending to the height of $\gamma$ Ursæ Majoris, at 2h. 10m. next morning. The sky was clear, and remarkably so during the forenoon. At 7 A. M., the magnetic intensity was high and remarkably variable; the time required for 100 oscillations of a suspended needle being 270 seconds at 7 o'clock, and 280 ten minutes later. Rain commenced at 9 P. M. of the 18th, about two days after the first appearance. Quantity during the night, .32 inch. On this day, the 18th, an aëronaut, Mr. Lauriat, who ascended from New York over Long Island, encountered what was called by the papers "a pretty severe snow storm in the upper regions; and when he touched terra firma, his clothes were frozen stiff."[*] The crystals may have been minute. The following is from another paper, and may perhaps refer to the same ascension. "In Mr. Lauriat's last ascension from New York, he ascended about five miles, and proceeded over a hundred miles. He passed through clouds of sleet, which covered his balloon with icy particles. But what was more interesting, he discovered that when he was at the greatest altitude, the needle of a compass which he had with him did not have the least tendency to exhibit polar attraction, but wavered about at all points of the compass."[†] May we not conclude, that the atmospheric magnets at the height of five miles acted more powerfully than the earth? Even at the surface, I have inferred, from many hundred observations, that the magnetic intensity is more affected by the formation of the higher clouds, and other obvious crystallizations, than by any periodical diurnal changes.

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[*] New York Commer. Adver. of August 19, 1836.

[†] Middlebury Free Press of Nov. 29, quoting the Boston Herald—date not given.

The following facts have also an interesting bearing on the theory. At Fort Enterprise, where Lieut. Hood found the aurora in one instance to be only 2½ miles high, he was, in two instances, surprised to see a discharge of snow, in small flakes, from a clear sky, at times when the aurora was active near the zenith.* These facts, with existing theories, were then extremely puzzling; but they are in exact accordance with the above theory. The short interval before the snow, and the diminutive flakes, are what might be expected in case of an extremely low aurora. Lieut. Hood's measurements and observations will not be disputed.

As early as 1820, (April 3,) my interest in the subject of the connection between the aurora and apparent clouds, was excited by a beautiful white arch, like a roll of wool, which on that evening was seen to detach itself from the summit of an aurora of the ordinary character, and in the rapidity of its motion toward the zenith, in the distinctness of its texture as it approached it, in the resemblance of this texture to that of a fleecy cloud, and in other circumstances, seems to have been unlike any arch in an elevated region.

Subsequently, an interesting class of objects of a more decidedly nepheological character, but still intermediate between the aurora borealis and ordinary clouds, has presented itself in polarized, linear cirri, or magnetic or auroral clouds. The linear cirri, when of great extent, and in other respects of a regular character, have generally been either in or near the magnetic meridian, or nearly at right angles to it. In hundreds of instances, these positions are within a degree or two of them. These can hardly have been accidental coincidences, and they have had no constant relation with wind. In epochs marked by auroras, these have been more marked. They are occasionally composite, consisting of an arch with rays, like streamers. Whence the polarity of these clouds? They open an interesting field, and establish a curious analogy between the aurora and the phenomena of the lower regions. Although the N. and S. delicate lines correspond with auroral streamers, in their coincidence with the meridian, yet the author has not confounded them, but has shown that the former differ from the latter in the absence of the dip.

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* See appendix to Franklin's Journey to the Polar Seas.

But the analogy is not restricted to position. It was soon detected in the concomitant phenomena. I have shown, by tabular views, that the thermometer usually begins to fall, and the barometer to rise, several days before each, and rain or snow to descend within one, two, or three days after them. In the cases subsequently presented, in which the number of hours between the aurora and storm has been carefully noted, I have usually found that the time has been about thirty six hours, and that there is a curious exception in the case of two auroras on two or three consecutive nights, in which case, the rain or snow is less likely to descend, or is deferred till nearly the usual time after the last. The same is true of the polarized clouds, and of halos; in both of which, vapor, which had unquestionably been precipitated, is redissolved, or otherwise disposed of, during the time and under the influence of the circumstances preparatory to or attendant on the second exhibition.

This interference of one aurora with the results of its predecessor, opens a curious field of investigation, discloses a new analogy between this and meteors of a confessedly aqueous origin, and refers to a general law the observed exceptions to the descent of precipitated vapor which so generally takes place after an aurora. In almost every instance in which this has been deferred, there have been traces of auroral action on the succeeding night, though sometimes masked by the moon. The following rule has had few exceptions, viz. If the evening of the day after an aurora is totally clear, no storm follows on the second day; and conversely, if no storm is to follow, this evening is *totally* or nearly clear. This general clearness is itself one of the usual attendants of auroral action; and I have for many years observed, that the morning following an aurora is, in this respect, remarkable, as compared with other mornings. In this fact, and in the unusual clearness of the night of the meteor—with the exception of some peculiar, transient clouds—we have proof of the influence of an aurora, or the circumstances which precede and attend it, in effecting the resolution or disappearance of visible vapor or precipitations.

This enables us to explain or generalize the fact of the nonappearance of the storm, of which the first of two consecutive auroras would have been the precursor. As tending to elucidate this new and interesting field of inquiry, I will state the results of observations on thirty two auroras observed at Schenectady, N. Y., between Oct. 5, 1830, and Nov. 3, 1833—the tables being prepared for these alone, although the results of subsequent observations are, I am persuaded, not less striking. My observations are made at 9 A. M. and 9 P. M. The proportions of sky clear at the times of observation, are set down in tenths. About one day before an aurora, the sky usually begins to increase in clearness. In the following results, reference was had only to clearness as compared with the corresponding hour of the preceding day, and only to mean results. During the 24 hours preceding the morning of the day on the evening of which the aurora occurred, the sum of the increments of clearness was to that of the decrements as two to one.* During the 24 hours immediately preceding the aurora, the increments are to the decrements as six to one. Similar results would be obtained by taking the number of instances in which the clearness increased or diminished in case of different auroras, instead of the amount of tenths, as above. Within the two days preceding an aurora, and on some part of the night of it, we observe all the circumstances preparatory to and connected with crystallizations in the high regions, developing themselves; such as increasing atmospheric pressure, increase of cold, and the disappearance of clouds. On the other hand, during the day or two succeeding it, are developed all those circumstances which attend a more advanced stage and lower descent of the products, whether crystalline or melted; such as a diminution of atmospheric pressure and clearness, and an elevation of the temperature and dew point. The latter changes, occupying less time, are more rapid than the former, and hence appear more striking. For example, during the 24 hours succeeding an aurora, the decrements of clearness are to the increments as 37 to 1. But this high ratio requires in reality to be further increased, in conformity with the principles above established. For, the principal increase of clearness which occurred, was in a single instance, and that on the occasion of two consecutive auroras; the latter tending to prolong and increase the clearness. This instance being omitted—as it should be—the decrements of clearness during the 24 hours succeeding the aurora are to the increments, as 112 to 1, the increment having been in one instance one tenth, and the whole decrement in thirty instances, 112 tenths. On none of the eight instances in which there were auroras on two consecutive nights, had the cloudiness increased on the evening of the second, as compared with that of the first. The mean decrement of clearness for the remaining 24 instances, was .46. Hence, to give a popular statement, approximately true—the evening of an aurora is, on an average, twice as clear as the succeeding evening, unless another aurora occurs on the latter; in which case, the sky continues equally clear. As the forenoon succeeding an aurora is in general unusually clear, this great decrement of clearness usually takes place in a few hours, whilst the increments had required several days.

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* The sum of the tenths which respectively express the amount by which the sky became clearer on the respective days immediately preceding the different auroras, is called, in expressing the mean results, the sum of the increments during the 24 hours immediately preceding the aurora. A similar expression is used for other epochs and for the decrements.

The following table, (abstracted from those on which the nine propositions are founded,) shows the mean temperatures at 9 P. M. of the days of the different meteors, and on the evenings one and two days previous; also the mean number of days previous, when the changes of pressure and temperature commenced.*

| Names of the meteors. | Number of observations on each kind. | Temperature two days previous. | Temperature one day previous. | Temperature at the time. | Time before when the barometer began to rise. | Time before when the thermometer began to fall. |
|---|---|---|---|---|---|---|
| Aurora Borealis, | 40 | 44.9° | 44.1° | 42.5° | 2.16 | 1.95 |
| Polarized clouds, | 22 | 40.5° | 37.2° | 35.2° | 1.90 | 2.12 |
| Halos, | 17 | 33.8° | 29.6° | 28.9° | 2.09 | 2.30 |
| Vertical beams, | 4 | 23.5° | 16.7° | 14.5° | 3.00 | 1.87 |

The number of vertical beams is so small, as to forbid confidence in mean results as to elapsed time. In the case of the other meteors, we see a pretty near correspondence as to the times when the thermometric and barometric changes commenced before them all; and find, in the relative temperatures required for them, a corroboration of the conclusion drawn from the time of the succeeding storm in relation to their relative heights in the air.

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* Certain errors which, through the inadvertence of an assistant, had crept into the tables, are here corrected.

The absolute temperature is, for the seasons of their occurrence, low for all, and of itself affords evidence of the existence of crystals. From semi-monthly observations for five years, on two springs at Schenectady, I have inferred, that the mean temperature of the earth there is 48.8°; and this accords nearly with the mean temperature of the air in that vicinity for the last ten years. Should we make allowance for the daily mean, and for the mean seasons of the year in which the aurora occurs, we should have a still more just and striking view of the cold usually required for its production. The barometer rises and the thermometer falls before an aurora, and the mean length of time is about two days; and consequently these changes commence about four days before the storm, or about three and a half days when there are not two auroras in succession.

This affords one of the earliest and surest prognostics of the storm, and is more to be relied on than even the subsequent depression of the barometer, which, in modern times at least, seems solely to have attracted attention. It would be curious, (though it is perhaps improbable, and I have not seen the original,) if this early ascent of the barometer were that alluded to in the long since banished rule of Pascal. Though this patriarch of this branch of science may, as is alledged, have fallen into a grave error in regard to this, yet there will be revived a certain modification of his rule, that the barometer rises before a storm; and perhaps he may be acquitted of the error and prove to be the original discoverer.

That the changes of pressure and temperature commence before the aurora, accords with the above theory. They are to be regarded as among the causes rather than the effects of the aurora. Yet that they continue a little beyond the time of it, I have long since observed, and expressed it by the rule, that the barometer is usually rising, and the thermometer falling, on the evening of an aurora.

Within a few years, an interesting confirmation of the above theory, so far, at least, as to the fact of a connexion between atmospheric vapor and magnetism, has been presented in many instances, at different times, in a peculiar deep blue, but not linear, cloud, resting on the horizon in the north, in the day time; its center of gravity being exactly, or almost exactly, in the magnetic meridian. Whenever the cloud was of this deep blue color, its direction was taken by the compass; and to avoid any bias from preconceived theory, a point judged to be the centre of gravity was selected, previous to the use of the needle. The variation from the meridian rarely exceeded a fraction of a degree; the correspondence in direction being more exact than that of the position of most polarized clouds. Had the writer been influenced by love of theory, he might have wished the latter and more explicable phenomenon to be the more regular of the two. He would invite the attention of more northern observers to this somewhat mysterious phenomenon, should the return of auroral epochs reproduce it. To those less favorably situated, he may appear to have drawn upon his imagination. Did time and space permit, he might give more particulars. He hopes occasionally to resume this and kindred subjects, so far as his present residence in a latitude less favored by auroral exhibitions, and his more exclusive devotion to professional duties will allow.

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## Art. XIV.—*Letters on Atlantic Steam Navigation.*

By Junius Smith.

### LETTER I.

London, 30th July, 1838.

TO BENJAMIN SILLIMAN, ESQ.

*Dear Sir*—Perceiving from your daily and periodical journals, that Atlantic steam navigation is attracting public attention in the United States, and having been in some measure instrumental in forming and maturing the plan here, perhaps the following remarks may not be altogether uninteresting at the present moment.

I do not mean to advocate the abandonment of the use of sails, whilst I shall endeavor to show that it is not a philosophical method of propelling a ship. It will be sufficient if I show that the application of steam power is both safer and more philosophical than the power of wind in navigation.

If you direct your attention to a sailing ship, you will find that she has three masts; that these masts are vertical levers; and of consequence, the direct tendency of these levers, when the power of wind is applied to their sails, is to upset, instead of to propel the ship. Hence we find, practically, that when the wind increases at sea, the shipmaster's first care is to take in the topsails, which is nothing more than shortening the levers upon which the power of wind acts. A ship going by the wind is capsized when the power acting upon the levers is greater than the resistance.

When a ship with her sails set is taken aback, she is hurried stern first into the depths of the ocean from the same cause, and not much time given to think about it, unless the levers are shortened in time, by taking in the sails, as a change in the position of the ship sufficiently quick, brings the acting power to bear in a different direction.

If the resisting power of the ship is sufficient to sustain her position on the water, and the levers are forced beyond their strength, then the ship is dismasted, and left, a helpless thing, to the mercy of the storm. The power always acts upon vertical levers, and daily practice, in sailing ships, shows the danger. In a steam ship, as such, the power is applied to a combination of short levers, acting horizontally upon the body of the ship, and in a direction the reverse of the power of wind upon sails, always propelling the ship forward, and never losing power by a collateral motion.

The paddle-wheels of the British Queen are 30 feet in diameter, of course about 93 feet in circumference. The floats are about three feet asunder, which will give thirty one sets of floats to each wheel. There are three floats in a cycloidal position in each set, nine and a half feet in the clear in length from one side of the wheel to the other, and one foot in breadth. Hence you will perceive that each set of floats has a superficial area of twenty eight and a half square feet, equal to 873 square feet for each wheel, and 1746 for both. The midship section of the British Queen presents a resistance of 550 square feet to be overcome by 1746 feet of the floats.

The mean speed of the wheels may be taken at sixteen revolutions per minute; and at that rate would run 29,760 yards per hour, equal to seventeen miles. If we deduct one fifth, the usual allowance, from the velocity of the periphery, to reduce it to the mean velocity of the wheel, we then have thirteen and a half miles per hour for the true speed of the ship by steam power. The distance from Portsmouth to New York is 3000 miles; and supposing the ship to run thirteen miles an hour, she would make the passage from port to port in nine and three quarters days. But we must not overlook the fact that the resistance of the water will increase as the square of the velocity of the ship; and therefore it may happen that the same power acting against an increased resistance, will not be found adequate to maintain the full speed which the calculation indicates. But I apprehend it cannot fall much short in velocity, and therefore cannot much exceed in the time required to perform the voyage.

Each set of floats is sustained by three radii, fifteen feet in length from the centre of the wheel to the periphery. But if we count these three radii as one lever of fifteen feet in length, then we have, by the combination of thirty one sets of levers, two equal to 232½ feet in length, acting horizontally upon the body of the ship, without the slightest tendency to throw her from an even keel. The danger of the ship's capsizing, of being taken aback, or of being dismasted, is entirely obviated, and the violence of the winds can have little other effect than that of disturbing the surface upon which she floats.

P. S. The President, of the same tonnage as the British Queen, is now building for the New York line, and will be followed by the Great Britain and the United States.

## LETTER II.

London, Sept. 5, 1838.

Having shown, in my letter of 31st July, that the navigation of a ship by steam power is more philosophical than by sails, because the power is applied to short levers, acting in a direction opposite to that of the power of wind upon sails, and always in a line horizontal to the body of the ship, and that therefore the danger of the ship's being capsized, or taken aback, or stranded, or dismasted, or strained by perpendicular levers, is entirely obviated; I proceed to suggest a few things relative to the practical results of sailing ships and steam ships.

Notwithstanding all that has been said and written upon the impracticability of navigating the Atlantic by steam ships, recent experiments have confounded the theoretically wise, and placed the affair upon a footing which no assaults can shake. Driven from their first position, these scientific champions have encamped upon another, confident that their position is impregnable. They indeed admit, because they cannot now deny, that it *is practicable* to navigate the Atlantic by steam ships; but they contend that the ships will not pay a profit to the proprietors. This is a question worthy of a minute and careful investigation. A fair and impartial inquiry may place the matter in so clear a point of view, that the plainest understanding will comprehend it. No doubt those who possess the most practical information on the subject, have nursed it for their own benefit, whilst those who are not confined to narrow thought and selfish views, and who would give some light to the understanding of others, have it not themselves to give.

*Whatever article of produce or manufacture can be exported or imported in a sailing ship, at a remunerating freight, can be exported or imported in a steam ship at a greater or equal profit, independently of passengers.* To elucidate this proposition, which I am aware the public mind is scarcely prepared to credit, it is necessary to go into some details of the working power of steam and sailing ships.

It will be borne in mind, that in constructing a steam ship for commercial purposes, independently of passengers, the expense will be much less, and the capacity for stowage much greater, than when both objects are combined.

If we build a steam ship of 2500 tons measurement, her capacity for stowing, exclusive of engines and fuel, will not be less than 1600 tons register,* equal to 2400 tons of measurement goods, of 40 cubic feet to the ton. A sailing ship of 400 tons register, upon the same scale of capacity, would take 600 tons of measurement goods.

For the sake of calculation, I will take the ports of New Orleans and Liverpool for the points of the ship's destination. I do not specify New Orleans as a more desirable port than any other in the United States for steam navigation, although I believe the commerce between that port and Europe may be carried on with singular facility and profit, especially as the Western Islands, Bermuda and Jamaica, offer natural stations for depôts of coal, and its vicinity to the Mexican territories opens a wide field for the combination of South American commerce with that of the United States and Great Britain; but by taking the extreme point of the United States, for the purpose of showing the advantages of steam navigation over sailing ships, it follows that all intermediate ports from New Orleans to Quebec, present at least equal relative advantages.

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* By a recent act of Parliament, the engine and coal rooms are deducted from the gross measurement, and the remainder is the legal register tonnage.

The following calculations, founded as far as practicable upon acknowledged data, will lead to a general result substantially correct, at all events sufficiently so to show the relative working power of steam and sailing ships.

A steam ship of 2500 tons, as mentioned above, deducting her engine and coal rooms, will leave her register tonnage 1600, and supposing her capacity for stowing to equal that of a sailing ship, she will carry 2400 tons of measurement goods.

A bale of New Orleans compressed cotton averages 20 cubic feet measurement, and 400 pounds weight; consequently, the ship would take two bales to a ton, equal to 4800 bales, for her entire cargo. If we assume one penny per pound freight, with five per cent. primage, it would be thirty five shillings a bale, or £8400 gross freight. Allowing the ship 73 days out and home, she would complete five voyages per annum, and bring home 24,000 bales of cotton, making a homeward freight of £42,000. If we suppose the ship to make only one quarter of a freight out, and I see no reason why she should not make a whole freight, that would give £2100 out, equal to £10,500 per annum, grossing, out and home, £52,500.

Let us examine, upon the same data, the working power of a sailing ship of 400 tons register, and see how many it will require to perform the same labor, and earn the same freight.

She will carry 600 tons of measurement goods, or 1200 bales of cotton, allowing her the same capacity for stowing as the steamer, and allowing her to complete two and a half voyages a year, which is as much as she can do, she will then bring home 3000 bales of cotton. It would therefore require eight ships, of 400 tons each, to carry the same quantity of cotton in twelve months as one steam ship, and to make the same freight out and home of £52,500. The relative power being the same, it makes no difference in the result, whether the ships carry more or less.

Seeing the work that one steam ship will perform, and having ascertained the number of sailing ships of equal tonnage capacity combined, required to perform the same, the only remaining material point now to consider, is the relative expense of navigation.

If it should appear that the expense of navigating one steam ship of 2500 tons is less than the expense of navigating eight sailing ships of 400 tons each, then I apprehend the proposition may be considered as proved; and it follows that it is more profitable to the ship owner to employ steam than sailing ships, independently of passengers.

NOTE.—New Orleans will probably cease to be a port of export and import of any importance within a few years. The great city of the west must be at the head waters of the Mississippi for foreign steam navigation. All the commerce will be carried on in steam ships, and they may as well go up the river for their freights, as the freights come down the river to them.

## EXPENSE OF NAVIGATION.

### *Eight Sailing Ships of* 400 *Tons each.*
### *One Sailing Ship* 12 *Months.*

| | | £ | s. | d. |
|---|---|---|---|---|
| 1 master, | at 10*l*. per mo. | 120 | 0 | 0 |
| 1 mate, | " 5 " | 60 | 0 | 0 |
| 1 2d do. | " 4 " | 48 | 0 | 0 |
| 1 steward, | " 3 " | 36 | 0 | 0 |
| 1 cook, | " 2 10 " | 30 | 0 | 0 |
| 1 carpenter, | " 4 " | 48 | 0 | 0 |
| 14 men, | " 2 10 " | 420 | 0 | 0 |
| 20 men for one ship, | | £762 | 0 | 0 |
| 8 ships, | | | | 8 |
| 160 men's wages, for 8 ships, is - - | | £6096 | 0 | 0 |
| Victualing 160 men, at 10*s*. each per week, is, per annum, - | | £4160 | 0 | 0 |
| *Port Charges at Liverpool.* | | | | |
| Pilotage out and in, £20 0 0 | | | | |
| Light & dock dues, 35 0 0 | | | | |
| For one ship, - £55 0 0 or for 8 ships, £440, which for two and a half voyages per annum, is - | | £1100 | 0 | 0 |
| *Port Charges at N. Orleans.* | | | | |
| Pilotage in and out, $100 | | | | |
| Levee fees, - - 50 | | | | |
| Towage up the river, 300 | | | | |
| Do. down do. 125 | | | | |
| $575 | | | | |
| Or £129 7*s*. 6*d*. for one ship, and for 8 ships is £1035, which for two and a half voyages per annum, is | | £2587 | 10 | 0 |
| Total for 8 ships, | | £13,943 | 10 | 0 |

### *One Steam Ship, of* 1600 *Tons Register.*
### *One Steam Ship* 12 *Months.*

| | | £ | s. | d. |
|---|---|---|---|---|
| 1 master, | at 20*l*. per mo. | 240 | 0 | 0 |
| 1 mate, | " 10 " | 120 | 0 | 0 |
| 1 2d do. | " 8 " | 96 | 0 | 0 |
| 1 3d do. | " 6 " | 72 | 0 | 0 |
| 25 seamen, | " 2 10 " | 750 | 0 | 0 |
| 1 engineer, | " 20 " | 240 | 0 | 0 |
| 1 2d do. | " 10 " | 120 | 0 | 0 |
| 1 3d do. | " 8 " | 96 | 0 | 0 |
| 12 firemen, | " 3 " | 432 | 0 | 0 |
| 1 cook, | " 2 10 " | 30 | 0 | 0 |
| 1 steward, | " 3 " | 36 | 0 | 0 |
| 1 carpenter, | " 4 " | 48 | 0 | 0 |
| 47 men's wages, - | | £2280 | 0 | 0 |
| Victualing 47 men, at 10*s*. ea. per week, per annum, | | 1222 | 0 | 0 |
| 1200 tons of coal each voyage—5 voyages per annum, at 12*s*. per ton at Liverpool, and 30*s*. at N. Orleans—6000 tons coal, average 21*s*. per ton, | | 6300 | 0 | 0 |
| *Port Charges at Liverpool.* | | | | |
| Pilotage out and in, £22 0 0 | | | | |
| Light & dock dues, 140 0 0 | | | | |
| £162 0 0 | | | | |
| For one voyage, or for five voyages, - | | £810 | 0 | 0 |
| *Port Charges at N. Orleans.* | | | | |
| Pilotage out and in, £25 0 0 | | | | |
| Levee fees, - 12 0 0 | | | | |
| (No towage req'd.) | | | | |
| £37 0 0 | | | | |
| For one voyage, or for five voyages, - - - | | 185 | 0 | 0 |
| | | £10,797 | 0 | 0 |

| | £ | s. | d. |
|---|---|---|---|
| Gross charges upon eight sailing ships, | £13,943 | 10 | 0 |
| Gross charges upon one steam ship, - | 10,797 | 0 | 0 |
| Difference, | £3,146 | 10 | 0 |

Thus it appears that one steam ship of 1600 tons register will perform the work of eight sailing ships of 400 tons each register in the freight of goods only between New Orleans and Liverpool, at less expense by £3146 10*s.* per annum. The petty expenses, such as reporting the ship at the custom-house, advertising, and the like, will always be in favor of the steam ships; but in showing the relative working power of the two classes of ships, it is not necessary to enumerate trifles. It will however be apparent to every candid inquirer, that if a steam ship can not only be supported by carrying goods at the same rate of freight as a sailing ship, but make a larger profit; that when the collateral advantages of passengers, speed, and certainty of time, are taken into consideration, the preponderance in favor of the steam is strikingly obvious.

Mercantile men will see, that as the time occupied by a steam ship in performing a voyage is not half that of a sailing ship, the sea risk is diminished in the same proportion, and consequently the premium of insurance will not be more than half the amount charged upon sailing ships.

The sooner the shipper can get his goods to market, the better for him; and if he can do it in half the time by a steam ship, that would be required by a sailing ship, it follows, as an inevitable consequence, that one half the capital would carry on the same amount of business in a steam ship, as would be required in sailing ships; because he could make two shipments or two importations, or both, in a steam ship, when he could make but one in a sailing ship. The whole commercial capital employed in foreign trade, upon the general introduction of steam navigation, will be doubled in its powers of carrying on commerce, and twice the amount of business done upon the present capital, or the same business upon half the capital.

If I have succeeded in establishing the proposition with which I commenced, then we may give rein, and allow the imagination to reach forward a few years, when sailing ships will become as rare as steam ships are now, and when the ocean will be covered with paddle-wheels instead of canvass.

Astronomers make the circumference of this earth 24,000 miles: steam navigators make it only 12,000. And although the breasts of men will still rage, and the sources of war remain, yet the nations of the earth will approximate, and a more subdued state of society lessen the calamities of war, and throw around its horrors something of humanity.

Civilization and intercourse go hand in hand. The light of science and the revelations of truth, blending their rays, and beaming upon barbarism, will soften down its character, and hasten the advent of more glorious times.

## MISCELLANIES.

### 1. *Report on the Shooting Stars of the 9th and 10th of August,* 1838; by Edward C. Herrick.

It was expected that an unusual display of shooting stars would be witnessed on or about the night of the 9th of August, 1838.* The arrival of this period was awaited with no ordinary interest, inasmuch as there was reason to hope that observations might then be made, which would remove some of the uncertainties which had hitherto rested upon the origin of this beautiful phenomenon. In this part of the country, observers were unfortunately deprived, by unfavorable weather, of any satisfactory view of the heavens during the season of the expected visitation. The accounts of observations which I have hitherto received from distant places, where the sky was clear, although not in every particular so complete as could be wished, are yet amply sufficient to show that the meteoric shower of August did not disappoint the expectations of those who looked for its recurrence during the present year.

#### I. *Observations made at New Haven.*

In order to obtain a thorough knowledge of the phases of this meteoric shower, it seemed necessary to observe on the nights of the 8th and 11th, as well as on those of the 9th and 10th. Accordingly, on the evening of the 8th, I kept a look out, and saw in half an hour, ending at 9h. 15m. *five* meteors, one of them more brilliant than Venus, with a splendid train. This number is not much above the average. At later periods of the night, the view was so much interrupted by clouds, that no regular observation was kept up. During the night of the 9th, the sky was entirely overcast. On the evening of the 10th, at the end of twilight, the sky was clear. Being myself occupied at that hour, Mr. *M. D. Bagg* kindly offered his assistance. Taking his station at 9h. and directing his attention towards the S. at an elevation of 80°, he saw in an hour 28 meteors: a lad, standing by, counted, during the same period, in the North,

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* See this Journal, Vol. 33, p. 402.

26. The moon rose at 9h. 42m. and, consequently, had thus far interfered very little. Between 10h. and 11h. Mr. B. counted in the same region, 20 meteors, which, considering the presence of the moon, is evidently an increase on the hour previous. Soon after 11h., as we were arranging for the night, clouds rapidly overspread the heavens, and frustrated all further observations. The entire night of the 11th was overcast and stormy. The evening of the 12th was beautifully clear, and even at this late date, it was evident, from a quarter of an hour's observation, that shooting stars were much more numerous than common. I regret that I could not conveniently watch throughout that night. Mr. E. Fitch informed me that in one hour, somewhere between 9h. and 11h. of that evening, he counted about 25 of these meteors.

## II. *Observations made at other places.*

1. At *Middletown*, Ct. watch was kept by Prof. *A. W. Smith*, and Messrs. *Knox* and *Rice*, of the Wesleyan University. During the whole night of the 9th, clouds covered the sky. On the night of the 10th, the sky was still cloudy, and afforded no opportunity for regular observation, but the observers were convinced that the meteors were more numerous than usual. No observations were attempted on the night of the 11th or 12th.

2. From *Geneva*, *N. Y.* Mr. *Azariah Smith*, Jr. writes, that on the evening of the 9th, about 9 P. M. the sky was partially clear in the North, and that on going abroad to observe, he "saw half a dozen meteors shoot across the open space in about the same number of minutes; after which, through the night, clouds covered the heavens. Of these meteors, all but one passed from the East to the West, and that one came from the zenith. Two were peculiarly bright and left long trains in their rear." No observations on the nights of 10th or 11th.

3. At *Buffalo*, *N. Y.* observations were made by Mr. *R. W. Haskins* and Dr. *C. H. Raymond*. On the morning of the 8th, from 1h. to 3h. 30m. they saw *fifteen* meteors, which is, of course, nothing unusual. "The morning of the 9th was densely clouded, with rain falling copiously." On the morning of the 10th, observations were commenced at 1h. A. M. "The state of the heavens was unfavorable. The moon, approaching the meridian, was so luminous as to obscure every star in her vicinity, save those of the first magnitude; the whole South, from this body to the horizon, covered with clouds, which were rapidly extending themselves over the other portions of the sky. At 2h. 30m. there was no clear sky to be seen. During this hour and a half, and under many disadvantages, forty meteors were counted" by the two observers. Mr. Haskins continues, "The appearances this morning, when taken in connection with all the adverse circumstances under which they were viewed, I am inclined to think were somewhat peculiar. Had there been

clear sky, absence of moon, and observers enough to have scanned every part of the heavens, it seems probable that meteors in considerable profusion might have been counted. Of those seen, the greater part left visible trains behind them, and many of them were seen through a haze which obscured all the smaller stars. As to a point of radiation: there are some facts connected with these observations that *may* indicate such a point; but they may, just as well, in our present state of knowledge, be wholly disconnected with the phenomenon, and certainly can not now be offered as proof on this point. The lines of flight of most of these meteors, if extended back, would cross near the tail of Camelopardalis, and this is the point, (55° R. A. 60° N. D.) which Mr. Schaeffer points out as the centre of radiation of the August shower of 1837. As a coincidence, this is perhaps worth mentioning, but certainly as nothing more at present." No observations on the night of the 10th or 11th.

4. At *Hudson, Ohio*, very good arrangements for observation were instituted by Professor *Loomis*, but they were almost entirely defeated by clouds. The report which he has published in the Cleveland Observer of Aug. 16, 1838, concludes thus:—"On the whole, then, although the total number of meteors seen here was small, on account of the very unfavorable state of the weather, the observations lend some support to the theory that meteors are unusually numerous about the 9th or 10th of August." No observations on the night of 10th or 11th.

5. At *Barren Hill*, about 12 miles N. of *Philadelphia, Pa.* observations were made on the night of the 8th by Mr. *Geo. C. Schaeffer*, who reports as follows: "The house from which I observed was in a valley, over which the smoke from the fire in New Jersey spread a mist like a curtain, which, illuminated by a full moon, formed a very unfavorable medium through which to observe. My view was limited to a small portion of the heavens, so that I could not have seen more than one fifth or sixth of the entire number visible in a clear and moonless night. Between 11h. 30m. and 12h. 30m. I saw about 20. From various estimates, I think they appeared [to a single observer] at the rate of 15 or 20 an hour. I watched very closely for the radiant point, and found it near where I placed it in August last, [see this Journal, Vol. 33, p. 134,] but, to my very great surprise, there was a constant and regular progression of this point. In this, I am not mistaken, as I devoted my whole attention to determine it. Between 11 and 12, it was about 1½° from ε Cassiopeiæ, in a line from it to the North Polar Star; it passed near the star first named, inclining downwards, and at 3h. it was 1½° or 2° on the other side of it." No observations on the night of 9th, 10th, or 11th.

6. At *Norfolk, Va.* observations were made on the evening of the 10th, by Messrs. *J. D. Dana, H. Eld*, Jr. and *J. W. E. Reid.* Mr. D. writes: "Between 8h. 55m. and 10h. P. M. we observed *thirty six*, which obviously far exceeds the usual number at that hour. They appeared to

radiate from Cassiopeia, but it was not very easy to determine satisfactorily, the radiant point. The sky, within 25° of the horizon, was obscured by a thick haze, which prevented our seeing any meteors below that altitude." At a later hour, the clouds and the moon rendered it unadvisable to resume the watch. No observations on the night of 9th or 11th.

7. At *Society Hill, S. C.* Mr. *William A. Sparks* watched, at intervals, on the night of the 9th and morning of the 10th. On the 9th, at evening, the sky was clear, and the number of meteors appeared somewhat unusual. "About 3h. A. M." (10th) writes Mr. S. "I was awaked by my servant, who informed me that 'he had seen five stars fall since he first got up.' I rose immediately and went out, and although the moon was shining with brilliancy, in mid-heaven, I saw at intervals of from two to five minutes, quite a number shooting in all directions. At 3h. 35m. one remarkably bright, which I noticed more particularly, took its origin in the vicinity of the belt of Orion, shot about 30° toward the N. nearly parallel to the horizon, and almost eclipsed the splendor of Venus, which was just then emerging from the East. At 3h. 45m. the sky became entirely overcast with cumulo-stratus clouds, which prevented further observation. On this occasion, I counted *twenty four* meteors." Mr. S. states, that on the nights of the 8th and 10th the displays were much inferior to that of the night of the 9th.

8. At *Wilmington Island*, near *Savannah, Ga.* Mr. *Thomas R. Dutton* made observations, which are far more extensive and satisfactory than any which have hitherto reached me. The following table contains a synopsis of the results.

| Date. | Time of Observation. | Number. | No. per hour. | Remarks. |
|---|---|---|---|---|
| 1838. | h. m. h. m. | | | |
| Aug. 9. | 9 30 P. M. to 11 30 P. M. | 19 | 9.5 | Moon rises at 9h. 25m. four days past full. |
| " " | 11 30 P. M. to 0 25 A. M. (10th) | 13 | 14.18 | |
| " 10. | 0 25 A. M. to 1 25 A. M. | 14 | 14. | |
| " " | 4 10 A. M. to 4 20 A. M. | 9 | 54. | |
| " " | 9 30 P. M. to 10 45 P. M. | 17 | 13.6 | Moon rises at 10h. five days past full. |
| " " | 11 20 P. M. to 0 20 A. M. (11th) | 24 | 24. | |
| " 11. | 0 30 A. M. to 1 30 A. M. | 26 | 26. | |
| " " | 3 A. M. to 4 A. M. | 55 | 55. | |

The following extracts are taken from the remarks which Mr. Dutton subjoins. "You will, I think, agree with me, that the present year presents, at this place, a recurrence of the meteoric shower of August last. In regard to *number*, two circumstances are to be considered: 1st, that there was but one observer; and 2d, that the moon was more than half full. It is generally admitted, that it requires, at least, three observers to note all, and that the full moon obscures two thirds or three fourths of those which would be visible in its absence. In the present case, we may safely say, that one half were rendered invisible by the light of the moon. On the night of the 10th, one observer saw 140, in 5h. 15m. [and 122 of them in 4h. 15m.] Three observers would have seen 420 during the same time, [and in the absence of the moon, 840.] On the night of Nov. 12, 1837, four observers saw at New Haven, 223 in five hours; the moon at that time obscuring, perhaps, one fourth more than in the present case.

"On the night of the 9th, the *centre of radiation* appeared to be near a point in R. A. 35° N. D. 69°. The more extended observations of the following night led me to place it somewhere between this point and ε Cassiopeiæ. I have more confidence in this conclusion, as on the night of the 10th, the meteors were more abundant, and several large ones started from near the radiating point. I can say with certainty that this point lay somewhere within the triangle formed by the three stars ε, ι, and ψ Cassiopeiæ. From this point radiated at least three fourths of all the meteors seen on the nights of the 9th and 10th. Of the meteors thus radiating two thirds had trains. It was remarkable that of all those which had trains, there was but *one* which did not move from the radiating point. As this point was during most of the time of observation somewhere between 20° and 60° above the horizon, and as the meteors generally made their appearance at more than 30° from this point, we should conclude that but few would be observed to fall directly towards the horizon. This was the case during the two nights. About fifteen were seen to descend towards the north; the remainder either rose, passing near the zenith, or moved towards the south in lines nearly parallel to the horizon. The *field of view* during the nights of 9th and 10th, was the northern and northwestern part of the heavens, including on the right the constellation Cassiopeia and extending 10° or 15° south of the zenith. From 3h. to 4h. on the morning of the 11th, I hardly noticed one which did not come from the radiating point. None of the meteors seen on previous nights (between July 28th and August 6th inclusive) seemed to have a common centre of radiation. As to *magnitudes*, it may be observed that the meteors were of two very distinct classes;—one composed of such meteors as are visible upon every clear night. This class contained one fourth of the whole number seen, and were distinguished by their small size, (not exceeding stars of the third magnitude,) by their unconformable directions, and their greater velocity. The other class, containing the remaining three fourths, were all as large as stars of the second magnitude, and half them were equal in size to Venus as she now appears as the morning star. Of this class, but *one* had a direction which could be called unconformable, and at least two thirds of them had trains. Most of the trains vanished as soon as the meteors which they followed, but in some cases they remained for one or two seconds, and were occasionally 15° or 20° long. The *velocity* of those meteors which were conformable was much less than that of those meteors which were unconformable, and much less also than that of those which are commonly seen. Those whose course was longest were visible from one and a half to two seconds. The *color* of these meteors was remarkably uniform, and was a reddish yellow, or flame color. In some cases the train was of a deeper color than its attendant meteor."

No facts concerning the appearance of this meteoric shower have yet been received from abroad. If the weather was favorable, observations were doubtless made in many parts of Europe. Especially may we expect a full report from M. *Quetelet*, of Brussels, who has done more than any one in Europe towards directing public attention to the subject of the occurrence of a meteoric shower in August.

## *Remarks on the preceding statements.*

Before we can determine whether the exhibition of last August was unusual, it is necessary to know the average number of shooting stars visible at other times. Numerous observations made in conjunction with my fellow-laborer, Mr. *A. B. Haile*, and occasionally with other friends, furnish some materials for the determination of this question. These were made chiefly in the fall, winter and spring months, but the results will probably apply without much error to the summer season. According to these observations, if the light of the sun and moon be absent, the average number of meteors visible at the most abundant season of the night, viz. from 3 to 6 A. M., is about *fifty* per hour; and from 6 to 10 P. M. about *twenty five* per hour. Of these a single observer would probably detect one fourth or one fifth part. Much difference however exists in the fertility of the different quarters of the sky at different hours, and many more observations must be made, before exact data on this part of the subject can be obtained. In the present state of our knowledge it seems not improper to multiply by *four*, the number seen by an individual, in order to obtain the whole number visible at the place during the period of his observation. What proportion of these meteors is concealed by the light of the moon at its different stages, cannot be fixed with minute accuracy. If we assume, that in the present instance one half were rendered invisible by the moonlight, it will doubtless be considered a liberal allowance. Looking at the foregoing accounts with these principles in view, it is evident that *the number of meteors seen in this country about the 10th of August*, 1838, *was from three to eight times beyond the average*. To specify a single instance;—Mr. T. R. Dutton, near Savannah, saw between 3h. and 4h. A. M. of the 11th, *fifty five* meteors.

Multiplying this number by *four*, and the resulting quantity by *two*, we obtain for the entire number which might have been seen at that place, had the moon been absent, 440, or about nine times the average. It is unnecessary here to reduce the other reports in this way, as any one who chooses can do it for himself.

The observations on the position of the radiant point of this shower are not altogether satisfactory, and it will probably be advisable to wait for the better opportunity of determining this point which the meteoric shower of August 1839 will present, rather than to attempt to reconcile the accounts which have been already made public. Enough is known to prove that this radiant (as seen in this latitude) lies fifty degrees north of the point towards which the earth is at the time tending. This fact may perhaps intimate that the meteoric zone does not lie in the plane of the ecliptic.

Neither can we yet decide on what day between the 8th and 12th of August the shower arrives at its maximum. The determination of this and other important features of the phenomenon must be postponed to the coming year.

We are probably still unacquainted with all those periods of the year at which shooting stars occur in unusual numbers. It cannot be concealed, that on the night of the *sixth of December*, 1798, *Brandes* alone saw these meteors at the rate of 100 an hour for four hours. This display must have been nearly or quite equal to any August or November shower which has been witnessed since 1833. It is a highly interesting question, whether shooting stars do not now occur in unusual numbers on or about this day of the year, and it is earnestly to be hoped that none of our observers will suffer this period of the present year to pass without the most attentive inspection of the heavens.

To the facts heretofore adduced in this Journal (Vol. xxxiii, p. 176—180; 354—364; 401, and Vol. xxxiv, p. 180—182) in proof of the occurrence of a meteoric shower in August, I add the following testimony, which although not of the most satisfactory character, seems to merit quotation.

1. In Miss Harriet Martineau's *Retrospect of Western Travel*, (Amer. ed. 2 vols. 12mo. N. Y. 1838,) Vol. 2, p. 87, is the annexed account, pertaining to the evening of August 8, 1835:—"While the bright glow was still lingering in the valley, and the sky was beginning to melt from crimson to the pale seagreen of evening, I saw something sailing in the air like a glistening golden balloon. * * * It burst in a broad flash and shower of green fire. It was the most splendid meteor I ever saw. * * I saw an unusual number of falling-stars before we reached home."

2. In Capt. J. E. Alexander's *Transatlantic Sketches*, (Amer. ed. 8vo. Philad. 1833,) p. 102, in an account of the tremendous hurricane which

visited the West Indies on the night of Wednesday, August 10, 1831, occurs the following. " * * Those who were driven into the fields, so far from being able to stand on their legs, could not even sit up, the wind was so violent as to throw them on their faces. The lightning flashed tremendously in their eyes and appeared to strike the ground only a few yards from them; but such was the roar of the wind, that the thunder could not be heard. *Innumerable fire-balls were seen to fall from the clouds.*"

The account of this hurricane which is copied from a Bridgetown (Barbadoes) paper into Lieut. Col. Reid's "*Attempt to develop the Law of Storms, &c.*" 8vo. London, 1838, gives the following additional particulars. "About 3 A. M. (Aug. 11) the wind occasionally abated. * * * The lightning also having ceased for a few moments only at a time, the blackness in which the town was enveloped was inexpressibly awful. Fiery meteors were presently seen falling from the heavens; one in particular, of a globular form and a deep red hue, was observed by the writer to descend perpendicularly from a vast height. It evidently fell by its specific gravity, and was not shot or propelled by an extraneous force. On approaching the earth with accelerated motion it assumed a dazzling whiteness and an elongated form, and dashing to the ground in Beckwith-Square, opposite the stores of Messrs. H. D. Grierson & Co., it splashed around in the same manner as melted metal would have done, and was instantly extinct. In shape and size it appeared much like a common barrel-shade (a glass cylinder put over candles in the tropics); its brilliancy and the spattering of its particles on meeting the earth gave it the resemblance of a body of quicksilver of equal bulk." p. 29.

New Haven, September, 1838.

## 2. *Observations made at Yale College on the Eclipse of the Sun of September* 18, 1838.—Communicated by Professor Olmsted.

I was prevented, by peculiar circumstances, from making any preparations for viewing the interesting eclipse of September 18th, having returned home from a journey only on the day of its occurrence. I found, however, that there was less reason for regret, as two young gentlemen of our senior class, *H. L. Smith* and *E. P. Mason*, had been very assiduous in making preparations for viewing the eclipse, having the necessary instruments all in readiness, and the time well regulated. Indeed, each of them was furnished with a good telescope of his own making, the former a Gregorian of three feet focus,* the latter a Newtonian of seven feet.

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* Messrs. H. L. Smith and F. Bradley have recently constructed a large telescope, of which they have furnished me the following memorandum: The reflector has a focal length of about fourteen feet and is one foot in diameter, of the Herschelian construction. The stand and adjustments are not yet completed, nor

Both accompanied me in the College Observatory, while I made use of our large Achromatic of ten feet focus.

The weather was remarkably fine. For some time previous, the atmosphere was cloudy, with some rain, and the prospects were very discouraging; yet only an hour or two before the eclipse came on, the clouds broke away, and presented a sky as clear and serene as could possibly be desired. Indeed, we were great gainers by the previous state of the atmosphere, the sky being washed clean of all vapors, while yet the sun had not shone long enough to disturb the tranquillity of the medium, by ascending and descending currents. Hence, there was a peculiar sharpness in the line presented by the solar disk.

Each of the three observers kept separate notes, but the observations of the commencement of the eclipse differed scarcely at all from each other, and none of them from the mean of the whole more than one fifth of a second. The average of the three gave the following results, expressed in mean time:

Beginning of the eclipse, . . . 3h. 21m. 14.47s.*
End, . . . . . . . 5h. 52m. 17s.

The profile of the moon projected on the sun's disk, as seen through the large Refractor (Clarke's Telescope) with a power of 180, presented a very irregular outline. One mountain in particular, (*Mons D'Alembert?*) near the centre of the margin, swelled out with striking prominence, having the rounded figure of an obtuse cone.

The darkness was not such as to make any of the stars visible to the naked eye; but a solemn, bronzy veil was thrown over the face of nature. The changes in the Barometer and Hygrometer, were inconsiderable; and the Thermometer suffered less reduction than it probably would have done had not the sun a short time previous emerged from a cloudy atmosphere. No change worthy of note was observed in the magnetic intensity.

Mr. Mason had attached to his telescope a divided object-glass micrometer, by means of which he made multiplied observations on the solar cusps, an account of which I am happy to subjoin in his own words,

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is the telescope in an advantageous position for making delicate observations. The tube is a twelve-sided prism, strengthened internally by iron rings. The following objects have already been seen, and the results will afford some idea of its power. The nebula in Hercules between η and ζ resolved into an immense number of small stars:—the annular nebula in Lyra very bright and distinct:—Debilissima inter 4 et 5 ε Lyræ, easily seen by direct vision:—small star near α Lyræ very bright and distinct:—ε Bootis, 4 and 5 ε Lyræ of course easily separated:—σ Coronæ Borealis, π Aquilæ, and the star south following μ Bootis very distinctly double:—ζ Orionis triple:—companion of Rigel very bright, even when the stars of the belt had disappeared in the morning light.

* It will be seen that this is 42.47 seconds later than the time given in the American Almanac.

deeming it unnecessary to add any remarks of my own, farther than to express my entire confidence in the accuracy of his determinations.

### *Micrometric Measurements taken by E. P. Mason.*

During the progress of the eclipse, frequent measures were taken of the distances of the cusps, and the corresponding instants of observation were accurately noted. The instrument with which these were obtained was an achromatic object-glass micrometer, of Dollond's construction, attached to a 7 ft. Reflector, the value of whose scale had been determined by frequent comparisons with an accurate sextant in terrestrial measures, and by observations on stars of the Ast. Soc. Catalogue. The following are the distances obtained:

| Time of Observation. | | | Distance of Cusps. | |
|---|---|---|---|---|
| h. | m. | s. | ′ | ″ |
| 3 | 26 | 6.8 | 10 | 23.43 |
| " | 27 | 49.1 | 12 | 1.63 |
| " | 29 | 51.2 | 13 | 37.14 |
| " | 30 | 58.0 | 14 | 28.11 |
| " | 31 | 42.9 | 14 | 57.48 |
| " | 32 | 43.7 | 15 | 35.92 |
| " | 35 | 5.4 | 17 | 2.18 |
| " | 38 | 19.2 | 18 | 36.72 |
| " | 42 | 2.2 | 20 | 23.52 |
| " | 43 | 18.5 | 20 | 57.98 |
| " | 44 | 26.9 | 21 | 20.87 |
| " | 47 | 53.9 | 22 | 36.54 |
| " | 48 | 35.7 | 22 | 54.58 |
| " | 50 | 37.9 | 23 | 32.79 |
| " | 52 | 44.6 | 24 | 12.57 |
| " | 54 | 16.8 | 24 | 38.56 |
| " | 55 | 6.2 | 24 | 52.99 |
| " | 55 | 48.1 | 25 | 2.61 |
| " | 58 | 33.6 | 25 | 46.78 |
| " | 59 | 18.0 | 25 | 59.69 |
| " | 59 | 52.9 | 26 | 6.48 |
| 4 | 1 | 55.0 | 26 | 27.62 |
| " | 8 | 6.0 | 27 | 46.16 |
| " | 9 | 13.9 | 27 | 57.91 |
| " | 10 | 11.7 | 28 | 1.93 |
| " | 12 | 21.3 | 28 | 22.52 |
| 4 | 14 | 15.0 | 28 | 33.16 |
| " | 15 | 12.9 | 28 | 44.39 |
| " | 16 | 37.7 | 28 | 53.88 |
| " | 17 | 36.6 | 29 | 5.53 |
| " | 31 | 36.3 | 29 | 8.68 |
| nearest approach | | | 19 | 13.59 |
| " | 51 | 41.9 | 29 | 16.77 |
| " | 53 | 18.8 | 29 | 24.40 |
| " | 55 | 44.2 | 29 | 23.38 |
| " | 58 | 39.5 | 29 | 13.26 |
| 5 | 0 | 49.7 | 29 | 4.88 |
| " | 1 | 38.6 | 28 | 55.68 |
| " | 2 | 28.0 | 28 | 53.51 |
| " | 3 | 16.4 | 28 | 48.51 |
| " | 4 | 10.8 | 28 | 41.66 |
| " | 7 | 55.3 | 28 | 6.79 |
| " | 8 | 34.2 | 28 | 2.44 |
| " | 9 | 26.0 | 27 | 53.38 |
| " | 11 | 24.3 | 27 | 29.23 |
| " | 12 | 18.7 | 27 | 19.43 |
| " | 13 | 40.4 | 26 | 56.76 |
| " | 14 | 39.3 | 26 | 50.70 |
| " | 16 | 42.1 | 26 | 16.15 |
| " | 18 | 18.8 | 25 | 57.65 |
| " | 19 | 56.1 | 25 | 37.30 |

A mean of 4 measures, in a direction about 15° or 20° inclined to the horizon, and 20m. previous to the instant of first contact, gave for the sun's diameter 31′ 53.7″. These were, however, taken amidst the hurry of preparation for the eclipse, and were too few in number to be a standard for the subsequent measures. The following horizontal diameters may be considered more determinate, and will serve to show the confidence which may be placed in the measures of the cusps:

| | |
|---|---|
| 5h. 15m. | 31′ 54.08″ |
| " " | " 53.20″ |
| " " | " 55.19″ |
| " 20m. | " 55.56″ |
| " " | " 55.64″ |
| " " | " 55.00″ |
| " " | " 54.82″ |
| " 27m. | " 54.95″ |

the mean of which is 31′ 54.81″. It should, however, be remarked, that a more perfect judgment can be formed of the exactness of contact of sharply terminated points, such as were the cusps during the eclipse, than can be the case with edges or limbs, as tremulous as that of the sun, where an alternate overlapping and recession leaves something to estimation. On this account, an attempt to obtain several measures of greatest distance of limbs was relinquished, both because greater inaccuracy was apprehended from the above source, and the measures of the cusps afforded a more advantageous method of arriving at the same results.

The maximum distance of the cusps, which may be obtained by interpolation from those nearest in point of time, will give the observed diameter of the moon, free, it is believed, from the effects of irradiation. The minimum distance will be a greatly magnified measure of the error of the moon's assumed latitude, the ratio of increase of the distance of the cusps at that point to the corresponding difference of the latitude being about as 25.7 : 1.*

At 5h. 20m. the measures of distance were relinquished, as the sun's proximity to the horizon would soon render any further observation of this kind of little value.

At the end of the eclipse, the sun was scarcely 3 degrees above the horizon, and the extreme undulation of his limb rendered much accuracy in the time of the observation impossible; and being, therefore, deemed of little importance, it was not carefully noted, and may possibly be in error.

The sidereal clock, from which the above determinations of time were taken and reduced, had been compared frequently during the months of August and September with transits of stars, and the deviations of the transit instrument, the value of the divisions of its level, and the irregularities of the clock's rate, carefully registered and applied. From a comparison of these observations, it appears, that the error of observation in the transit of a single wire is seldom over .3 of a second; and the mean of the 5 wires of the instrument would, therefore, render the probable error certainly less than .1 of a second. The error arising from irregularity of the clock's rate is rendered of comparatively little moment by the fortunate coincidence, nearly, of the transit of Antares with the middle of the eclipse. The only remaining error of importance, that of the imperfection of vision, in noticing the first moment of ingress, may be presumed to be very small, from the circumstance that the observations were entirely independent, at two different clocks, in separate apartments, and the coincidence of results was not mutually known till some minutes afterwards, thereby preventing the otherwise natural result of catching the first glimpse by contagion. The agreement of the times of commencement to less than .2 of a second, under such circumstances, goes far to prove their accuracy. The clocks were compared by coincident beats immediately before and after the ingress.

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* The moon's latitude, as assumed for the calculation of the eclipse in the American Almanac, is by the observation of the nearest approach of cusps, 10.05″ too large; a determination which, if the calculated semidiameters of the sun and moon be correct, is in error by only one nineteenth part of the error of observation.

The distances of the cusps are uncorrected for difference of refraction, which, in the last measures, is of considerable amount. If any of them should be found discordant with the others, from error in counting from the clock, or in registering, they will easily be discovered in the calculation, and corrected, if the mistake is evident, or otherwise entirely rejected.

3. *Supposed new mineral at Bolton, Mass.*—The following angles were obtained with the reflective goniometer, from a small crystal of a green mineral, sparingly disseminated in massive Scapolite, at the Bolton lime quarry. It occurs in small isolated prismatic individuals, imperfectly crystalline, or in divergent groups of slender flattened prisms, more or less perfect. The mineral has been considered Gadolinite, and by Prof. SHEPARD, who early observed it at the above locality, as Allanite, to which it is closely allied, if not identical with it.

The primary is an oblique rhomboidal prism, M : T = 113° 45′ and 66° 15′; M : ē (replacement of *obtuse* lateral edge) = 149°, T : ē = 144° 45′, M : ĕ (replacement of *acute* lateral edge) = 128° 45′, T : ĕ = 117° 30′, ĕ : ē = 97° 45′ and 82° 15′. The crystals are flattened parallel with ē, and slightly resemble some varieties of green hornblende. M is bright, T much less so; ĕ is deeply channeled. No cleavage apparent. H. = 5.75. G. as found by Prof. S. 3—3.25, the former obtained with a fragment weighing 1.2 grains; the latter, with 2 centigrammes, or about one third of a grain. *Lustre*, resinous; *streak*, greyish or greenish white. *Color*, grass green—blackish green; translucent—subtranslucent; brittle.

A black variety occurs in the Petalite of the same quarry, which, in lustre and color, much resembles Allanite. The above angles and other characters seem, however, to indicate that this mineral is a distinct species. If it should prove, however, on further examination, identical with Allanite, the above angles, as they were taken with the reflective goniometer, should be substituted for those usually given, which were obtained with the common goniometer.

I have not observed any terminal planes, but infer the probable obliquity of the primary, from the direction of a seam of carbonate of lime, which intersected the crystal. If we can place any dependence on this kind of evidence, the crystal is oblique from an *obtuse* edge.

The scapolite in which the mineral is found, contains, also, exceedingly minute zircons, scarcely $\frac{1}{16}$ inch long, and also very small prisms of rutile. The zircons are square prisms, having the lateral edges truncated, and pyramidally terminated at each extremity; a narrow intermediary plane replaces the edge between a pyramidal plane, and one truncating a lateral edge. They are described in Naumann's System of Crystallographic Notation, as follows: $\infty P \infty . \infty P . P . 2P2$. J. D. DANA.

July, 1838.

4. *New locality of Crichtonite.*—This mineral is found in the north part of Litchfield, Ct. about two miles from the village. The locality is upon the east side of the road, leading from the Wolcottville turnpike to Torrington, on the land of Mr. John A. Woodruff. It occurs crystallized in short hexagonal prisms, with the alternate angles replaced by single planes, inclining upon the base, at an angle of 121°, and upon the lateral planes, at an angle of 134°. The largest of the crystals are about three quarters of an inch in length, and two and one quarter inches in diameter. It is found imbedded in fragments of rock composed of quartz and mica slate. The prevailing rock is mica slate, from which these probably have been detached.

The mica slate also contains an abundance of staurotide. A common form of the crystals is that of the primary form, with the obtuse angles replaced. Some of them are four inches in length.

*Y. C. Aug.* 1838. T. S. GOLD, A. B.

5. *Stilbite, Chabasie, and other minerals, at Stonington, Ct.*—Stilbite has been found within cavities in gneiss on the Stonington rail road, two miles and a quarter from that village. It is imperfectly crystallized, being composed chiefly of implanted globules, with occasional botryoidal masses, which, when broken, present the stellated structure common in this species. It is of a wax-yellow color, and subresinous lustre. Some specimens are of a light yellow color.

*Chabasie.*—In connection with the above, were found very minute crystals of Chabasie, of a light red color. But in a ledge on the rail road, a quarter of a mile further from its termination at Stonington, were found in rather more abundance, aggregated crystals of a deep carnation red color. The crystals are very obtuse rhombohedra, from one fifth to one tenth of an inch in diameter. Owing to the brittleness of these minerals and the great hardness of the rocks in which they are imbedded, none but small fragments can be obtained, unless expensive excavations are made.

Associated with the above mentioned minerals are also found small traces of the following:

1. Zeolite, in small masses, whose fracture presents stellated radiations of a pink color. Their size varies from one fifth to half an inch in diameter.

2. Calcareous Spar, (with the last mentioned Chabasie) in hexagonal prisms; and at the other ledge, in compact masses.

3. Scapolite, of an imperfectly crystalline structure, and light green color, partly decomposed.

4. Sphene, in two or three minute black crystals.

5. Apatite, in small crystals of a bluish green color.

6. Magnetic Iron, in small masses.

In a ledge on the rail road, three miles and three quarters from the village of Stonington, are several veins of quartz, partly compact and in part composed of interlocking crystals. In two of these, which were from half an inch to an inch and a half in thickness, was found a layer of Fluor. It is generally about one fifth of an inch in thickness, varying, however, from one third to one tenth of an inch. The colors are light green and dark purple.

Traces of the same mineral were found in other veins at the same ledge.

At this place were also found thin veins of calcareous spar, dolomite, and serpentine. W. W. Rodman, A. B.

*Yale College, Aug.* 1838.

6. *Crichtonite, in R. I.*—It is found in the town of Westerly, R. I. in a ledge of gneiss, which has been quarried for building stone, on land owned by Mr. Nathan F. Dixon. It is situated one fourth of a mile north of the 6th mile stone, on the Stonington rail road. The mineral, in imperfect crystals, is disseminated through a mass of semi-crystallized quartz, which is two or three feet in length, and about one foot in width and breadth, W. W. R.

7. *A Flora of North America: containing abridged descriptions of all the known indigenous and naturalized plants, growing north of Mexico; arranged according to the Natural System:* By John Torrey and Asa Gray. Vol. I, Pt. 1, pp. 184 8vo. G. & C. Carvill & Co. N. York, 1838.

Here is the first number, and the *earnest* of a work, which has been long and anxiously desired by the botanists of the United States; and which will, doubtless, be cordially greeted by the cultivators of botanical science, throughout the world. The plants of North America have always been regarded with a lively interest. They have, at various times, attracted hither a number of botanists from the old world, who have reaped a rich harvest of discovery in our forests, on our mountains and prairies, and along the margins of our almost interminable rivers. A few of our own countrymen have also rendered important aid in making known the character and extent of our vegetable treasures. Their labors, however, have been, for the most part, restricted to the production of *partial* or *local Floras*, highly interesting, indeed, so far as they extended, and furnishing valuable materials for a more comprehensive work; but still, they were severally limited in their scope, and, of necessity, incomplete in their contents. The materials thus existing in detached masses, and scattered through numerous volumes, awaited the plastic operation of some master hand, to reduce them into one consistent body, and give to all the parts their appropriate "form and pressure." It was exceedingly important, that whoever might undertake to prepare a North American Flora, should be thoroughly acquainted with the labors of preceding botanists; and, by consulting their collections, as far as practicable, be competent to detect their errors, adjust their discrepancies, and determine their various synonyms. We consider it, therefore, a subject of felicitation, that the work has fallen into the present hands, as being confessedly those among the best qualified for the task, in our country; and we rely with confidence upon their receiving the zealous cooperation and encouragement of every lover of the Science of Plants. We cannot for a moment doubt, that every American botanist will eagerly avail himself of the occasion to possess a complete Flora of our widely extended continent; and we should fondly hope, that every liberal cultivator of science in our land, would be happy in the opportunity to patronize so commendable an effort to enhance the national reputation.

The authors of this Flora have, of course, adopted the *natural system*, as being the only one consistent with a truly scientific arrangement of plants; and they have availed themselves of the latest discoveries, in order to exhibit the details according to the most approved method, in the present state of the science.

By issuing the work in *parts*, or numbers, some advantages will be secured, which would otherwise be unattainable. The *natural families* being complete, even in those detached numbers, the botanists in various parts of our country will have leisure to examine and verify the particulars of each, during the course of the publication; and thus may suggest, in due time for an *Appendix*, (which must ever accompany works on a progressive science,) such corrections, modifications, or additions, as their opportunities or discoveries shall enable them to make. In this way, much valuable aid may be furnished to the authors, and the Flora rendered more perfect and comprehensive, without occasioning any material delay in its final completion.

The characters of the orders, tribes and genera, are well defined; and the specific descriptions, though abridged, are sufficiently full to be clear and satisfactory. They are, moreover, frequently accompanied with notes and detailed remarks, (especially the less known, or newly discovered species,) which seem to supply all the information that can reasonably be desired, in the Flora of so extensive a region.

The additions derived from the recent discoveries of Mr. NUTTALL, during his journey to the western coast of this continent, are highly important; and are here published, for the first time, from the original manuscript, furnished by that distinguished and indefatigable naturalist.

It appears, by a notice affixed to the number just published, that the work will be issued in nine parts, three parts to make a volume, and the whole forming three closely printed octavos, of about 550 pages each. The succeeding numbers will appear with as much dispatch as is consistent with their faithful execution.

Such being the character and plan of the forthcoming *Flora of North America*, we conclude our brief and hasty notice with a reiterated expression of the hope, that the worthy and accomplished authors may be adequately encouraged to persevere in their most laudable undertaking, and thereby be enabled to bring it to a successful and speedy completion.

*August* 16, 1838. W. D.

8. *Redfield's Law of Storms:—Notice of Col. Reid's Work on Hurricanes.*—It is well known to the readers of this Journal, that our valued friend and correspondent, Mr. William C. Redfield, now of New York, has for a long course of years zealously prosecuted the study of various topics of Meteorology, and especially that of the phenomena of the storms of the Atlantic coast. To the latter subject his attention was directed as early as 1821, by the memorable hurricane which passed over our State with destructive violence, in September of that year. An investigation of its phases at different places, brought him to the highly interesting conclusion, that this storm was a progressive whirlwind, whose path could be traced from the West Indies to the Province of New Brunswick. In order to determine if the other storms were of this character, Mr. R. pursued the very judicious method of "mapping out on a chart, all the facts in relation to the storm, which he could collect, in their true time and location," (see this Journal for July, 1835,) and his labors were rewarded with the very important discovery, that *the violent storms of the Northern hemisphere are whirlwinds on a grand scale, each revolving or gyrating from right to left, originating within the tropics, advancing Westerly at first, in a line curving to the North, turning near the latitude of* 30° *N. and thence pursuing a Northeasterly course.* This view of the matter, although often advanced previously by Mr. R. among his acquaintances, (as many of us can testify,) was not made public until 1831, when it ap-

peared in a paper received in 1830, and published in the 20th Vol. of this Journal.

The numerous investigations of the phenomena of hurricanes, as observed at different points of their path, which Mr. R. has since made, have only added new confirmation of his early opinions. Several of his papers, embracing some of the results of these labors, have at various times appeared in this Journal, and in other periodical works. That which was published in 1835, was accompanied with a chart, showing the tracks of eleven different gales or storms. His explanation of the barometric indications observed during the access, progress, and departure of these storms, appears to us original, ingenious, and true; and his directions to navigators, concerning the measures which they should adopt, to extricate themselves from their destructive grasp, are surely of the highest practical importance. In an article published in this Journal in 1833, Mr. R. announced the conclusion, from data which he had collected, that the storms of the Southern hemisphere pursue a counter direction, and gyrate in the contrary way from those of the Northern: a difference which he considers due to their dependence on the earth's rotation.

These doctrines, (of which the foregoing is but an imperfect statement,) being so unlike those which had, for a long time held universal sway, were received by most, with great hesitation, and by some, with determined opposition. There were, however, those among us, who had watched the movements of the barometer, and the changes of the wind, during these storms, and were satisfied of the truth of the new system. Within a year or two, the attention of philosophers in foreign countries has been turned to this subject, and recent occurrences indicate that the laws of storms, which Mr. Redfield has unfolded, will soon be universally acknowledged. The preceding remarks are elicited by the perusal of an elaborate work, published the present year in London, by Lieut. Col. W. Reid, of the Royal Engineers, entitled "*An attempt to develop the Law of Storms, by means of facts arranged according to place and time, and hence to point out a cause for the variable winds, with the view to practical use in Navigation, illustrated by* [9] *charts and wood cuts,*" pp. 436, R. 8vo. The author states, that his attention was first drawn to the subject, by the Barbadoes hurricane of August, 1831, when he was induced to search every where, in the hope of learning the causes and mode of action of these storms. "The first paper," says Col. R. "I met with, which appeared to convey any just opinion on the nature of hurricanes, was one published in the American Journal of Science, by Mr. W. C. Redfield, of New York." Embracing with ready zeal, the views advanced in that paper, Col. Reid has prosecuted the study of his subject, with good judgment and praiseworthy industry. In the volume before us, he has presented the most convincing demonstration of the truth of Mr. Redfield's doctrines, and by the aid of numerous and excellent charts and diagrams, he has set forth the subject with great clearness and beauty. His exhibition of the storms of the Southern hemisphere is full and satisfactory, and entirely accordant with Mr. R.'s published statements. As Americans, we can not but feel much gratified with the frankness with which he attributes to our countryman the credit of establishing the true system, on a subject of such interest and magnitude. The skill and research with which the work is executed, and the candor with which he ascribes honor where honor is due, are creditable alike to the head and heart of its author. The volume deserves attentive study; as the matters of which it treats, and the results which it presents, are not only interesting to the theoretical philosopher, but also of immense importance to all who expose their lives or their fortunes to the perils of the ocean.

9. *Observations on the genus Unio, together with descriptions of new genera and species in the families Naiades, Colimacea, Lymnæana, Melaniana, and Peristomiana, with numerous colored plates:* by Isaac Lea, Member Amer. Philos. Soc. etc. Vol. II, quarto, pp. 152. Philadelphia—(constituting Trans. of Amer. Phil. Soc. Vol. VI, Part 1.)

The present volume consists of several papers read before the American Philosophical Society, from Dec. 19, 1834, to July 21, 1837; and embracing descriptions of the following new species of shells, to the names of which we annex their *habitats* :

| | | | |
|---|---|---|---|
| *Unio arctior,* | Ohio river. | *Unio jejunus,* | S. Car. |
| “ *solidus,* | “ | “ *pumilus,* | N. Car. |
| “ *Rangianus,* | “ | “ *Roanokensis,* | “ |
| “ *graniferus,* | Ohio. | “ *Hopetonensis,* | Georgia. |
| “ *Dorfeuillianus,* | “ | “ *lugubris,* | “ |
| “ *coccineus,* | “ | “ *folliculatus,* | “ |
| “ *pulcher,* | Tennessee. | “ *Lecontianus,* | “ |
| “ *obscurus,* | “ | “ *spinosus,* | “ |
| “ *interruptus,* | “ | “ *splendidus,* | “ |
| “ *Cumberlandicus,* | “ | “ *dolabræformis,* | “ |
| “ *simus,* | “ | “ *Jayensis,* | Florida. |
| “ *notatus,* | “ | “ *Claibornensis,* | Ala. |
| “ *Barnesianus,* | “ | “ *turgidus,* | Louisiana. |
| “ *Zeiglerianus,* | “ | “ *Hydianus,* | “ |
| “ *creperus,* | “ | “ *Fisherianus,* | Maryland. |
| “ *glaber,* | “ | “ *Novi-Eboraci,* | New York. |
| “ *gibber,* | “ | “ *Tappanianus,* | Penn. |
| “ *Vanuxemensis,* | “ | “ *Tampicoensis,* | Mexico. |
| “ *Muhlfeldianus,* | “ | “ *carbonarius,* | “ |
| “ *Menkianus,* | “ | “ *pliciferus,* | “ |
| “ *venustus,* | Potosi, Mo. | “ *Medellinus,* | “ |
| “ *Vaughanianus,* | S. Car. | “ *Brownianus,* | Amazon river. |

*Unio Bengalensis*, Bengal.
" *lamellatus*, "
*Margaritana Holstonia*, Tenn.
" *deltoidea*, "
*Anodonta ovata*, Ohio.
" *salmonia*, "
" *Wardiana*, "
" *Buchanensis*, "
" *decora*, "
" *pavonia*, "
" *Pepiniana*, "
" *gigantea*, Fort Gibson.

*Unio discus*, India.
" *contradens*, Unknown.
*Margaritana fabula*, Tenn.
" *arcula*, Georgia.
*Anodonta Newtoniensis*, Penn.
" *subcylindracea*, N. York.
" *cylindracea*, Mexico.
" *angulata*, W. of Rock. Mts.
" *Oregonensis*, "
" *Nuttalliana*, "
" *Wahlamatensis*, "
" *exilis*, Unknown.

*Iridina cælestis*, Africa.
*Helix Mitchelliana*, Ohio.
" *Wardiana*, "
" *Vancouverensis*, W. Rocky Mts.
" *Nuttalliana*, "
" *Columbiana*, "
" *Townsendiana*, "
" *Oregonensis*, "
" *Californiensis*, Upper California.
" *Nickliniana*, "
" *magnifica*, New Granada.
*Carocolla Hydiana*, Porto Cabello, S. A.
*Polygyra Dorfeuilliana*, Tenn.
" *Troostiana*, "
*Bulimus lacteus*, Colombia, S. A.
" *Pealianus*, "
" *Colombianus*, "
" *corneus*, "
" *glandiformis*, New Granada.
" *parvus*, Carthagena, S. A.
" *virgo*, "
*Succinea aperta*, W. of Rocky Mts.
*Megaspira** *Ruschenbergiana*, Brazil.
*Cyclostoma maculata*, Manilla.
" *Popayana*, New Granada.
*Planorbis lens*, Ohio.
*Physa aurea*, Virginia.
*Lymnea solida*, W. of the Rocky Mts.
" *apicina*, "

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* A new genus allied to *Bulimus*, *Pupa*, and *Auricula*. The name alludes to μεγας magnus, and σπειρα spira.

*Melania inflata*, Virginia.
" *plicata*, Bengal?
" *plicifera*, W. of the Rocky Mts.
" *Troostiana*, Tenn.
*Paludina pallida*, Ohio.
" *Nickliniana*, Virginia.
" *sinistrosa*, East Indies.
" *nuclea*, W. of the Rocky Mts.
" *Nuttalliana*, "
" *virens*, "
*Ampullaria Pealiana*, Colombia, S. A.

The volume includes, likewise, a series of very interesting observations upon the anatomical structure of the *Naiades*, illustrated by plates; from which we perceive that Mr. LEA is convinced that these animals are not *androgynous*, as has heretofore been believed in Europe, but, on the contrary, have the sexes in different individuals. He notices, under these remarks, with suitable commendation, the ingenious memoir of Dr. KIRTLAND, of Ohio, on the same subject.* The work is concluded by a very valuable synopsis of *Naiades*, in which the embarrassing synonymy of this family is cleared up with the author's usual address. It contains, according to this review, 323 recent species, as admitted, *(rank and file,)* 29 unknown to the author or doubtful, *(missing,)* and 22 fossil, *(dead.)* Of the subgenus *Unio*, there are 235 species in a recent state, and 20 which he has not been able to admit as certain. Of fossil species 21. Of the subgenus *Margaritana*, there are 20 admitted species and 2 unknown. Of the subgenus *Dipsas*, 2 recent species. Of *Anodonta*, 58 admitted, 7 unknown, and 1 fossil, which is doubtful. Of *Iridina*, 2 recent species: and of *Spatha*, 6 recent species. C. U. S.

10. *North American Herpetology; or a Description of the Reptiles inhabiting the United States;* by JOHN EDWARDS HOLBROOK, M. D., Professor of Anatomy in the Medical College of the State of South Carolina, Member of the Royal Medical Society of Edinburgh, &c. &c. Vol. I, quarto. Philad. 1836. pp. 120; and Vol. II. 1838. pp. 125. With colored engravings.

This is a second great work on natural history from the Philadelphia press, concerning which we have long owed a notice to the scientific public. Its merits are, however, of so high an order, as to stand in very little need of commendation, and the volumes before us give the best assurance that the remaining ones will be executed with equal ability. To distant subscribers, it may be of some consequence to be informed of the progress which Dr. HOLBROOK has made in his undertaking—a task, to the undertaking of which, it is well known that he was encouraged by the late Baron CUVIER, an individual who well knew into what channels to direct the attention of his friends and pupils.

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* See this Journal, Vol. XXVI.

The author remarks in the preface of his first volume, "In no department of American Zoology is there so much confusion as in Herpetology. This is to be traced partly to the earlier naturalists, partly to the practice of describing from specimens preserved in alcohol, or from prepared skins. I have endeavored to avoid error in this respect, by describing, in every instance from the living animal, and often after a comparison of many individuals."

The first volume contains an extremely lucid essay on the organization of Reptiles, and descriptions of the following species: *Testudo Polyphemus, Emys hieroglyphica, E. megacephala, E. Troostii, E. Muhlenbergii, Ameiva sex-lineata, Anolius Carolinensis, Scincus lateralis, Bufo Americanus, B. clamosus, Engystoma Carolinense, Scaphiopus solitarius, Rana halecina, R. palustris, R. sylvatica, R. ornata, Hyla versicolor, H. squirella, Coluber flagelliformis, C. Alleghaniensis, C. quadrivittatus, C. erythrogrammus, C. abacurus.*

The second volume contains the following species: *Emys Oregoniensis, E. terrapin, E. picta, E. guttata, E. serrata, E. rubriventris, E. reticulata, E. floridana, E. mobilensis, Salamandra dorsalis, S. symmetrica, S. gutto-lineata, Trigonocephalus piscivorus, T. contortrix, Crotalus miliarius, C. adamanteus, C. durissus, Elaps fulvus, Coluber erythrogaster, C. fasciatus, Heterodon platirhinos, Scincus erythrocephalus, Heteradon niger, Coluber guttatus, C. taxispilotus, C. punctatus, C. æstivus, C. elapsoides.*

We regret to learn that the first volume is nearly or quite out of print. It is to be hoped, however, that a second impression will soon be supplied. From the preface of the second volume we perceive, that drawings are ready for the third volume, which will probably be followed by two others before the subject will be exhausted.

11. *Second Part to* SHEPARD'S *Descriptive Mineralogy*, is now preparing for the press, and will shortly be published by *Wiley & Putnam*, of New York, and *Grigg & Elliot*, of Philadelphia. It is intended to embrace a view of the progress of the science since 1835, the year in which the first part of the work was printed.

12. *Blowpipe mouth for Oxygen and Hydrogen.*—In the late edition of Dr. Turner's Chemistry, much credit is given to Prof. Daniell, of London, for the invention of a new jet to the compound blowpipe, which is calculated greatly to increase the safety of that apparatus. Mr. Daniell has also given an engraving and description of the same, in the Philosophical Magazine, Vol. II, p. 57, 3d series. The jet, about 5 inches in length, is composed of two concentric tubes, each terminated by plati-

num; the gases pass through, one within the inner tube, and the other along the space between the two; so that no mixture or communication can take place until they arrive at the outlet. There is another advantage attending this arrangement, viz. that either of the gases can be made to surround the other, at pleasure; and any quantity of the gases can be employed, and large masses of platinum can be melted. This jet was contrived by Professor Webster, of Cambridge, Mass. in 1824, who sent a drawing and model of it to Mr. Newman, the well known maker of philosophical instruments, in London, by whom a jet was made and sent over, which Dr. W. has continued to use in his lectures and on all occasions, ever since, with perfect safety. A jet, on the same principle, was previously devised by Dr. W. and figured in his Manual of Chemistry, edit. 1 and 2. This was wholly of brass, and made by Dwelle, of Boston. An improvement was made by introducing one of the gases into the end of the central tube, instead of the side.

13. *Analysis of the Mineral Waters of Avon. By Samuel Salisbury, Jr. M. D.* 1838.—The sulphureous waters of Avon, Livingston County, N. Y. have long been known and were used even by the aborigines, in cutaneous disorders. Of late, they have been much frequented by the throng of valetudinarians, who resort to similar places for health and pleasure: and in many diseases they have proved to be of the most decided utility.

Dr. Salisbury, who is a resident physician at Avon, has devoted himself to studying the chemical constitution and medicinal qualities of these springs. He finds their temperature not above 45° to 47°, which is about the usual temperature of wells and springs in that climate. The chemical constitution of the "lower spring," as it is called, from its position, "is by weight in 8000 parts of water, hydro-sulphuric acid, 493; carbonic acid, 1.36; nitrogen and oxygen, .272; chlorine, .73; sulphuric acid, 10.116; carbonate of lime, 4.08; lime, 3.86; soda, .84; magnesia, 2.31; specific gravity, 10.018.

Arranged so as to form the compounds existing in this water, and calculated for 10,000 parts by weight, are—

| | | |
|---|---|---|
| Carbonate of lime, | 5.02 | |
| united to carbonic acid, | 1.70 | —6.72 |
| Chloride of calcium, | | 1.44 |
| Sulphate of lime, | | 9.83 |
| " magnesia, | | 8.49 |
| " soda, | | 2.35 |
| | | 28.83 |

In a volume of 10,000 parts, are—

| | |
|---|---|
| Hydro-sulphuric acid, | 434 |
| Nitrogen, | 235 |
| Oxygen, | 25 |
| | 694 |

*Note.*—The chlorine is assigned to calcium, as the chloride of calcium is oftener found in those waters which contain but little saline matter. There remains .006 sulphuric acid, apparently in excess, which is accounted for by the difficulty of separating, accurately, magnesia from the other earthy salts. The quantity of carbonate of lime considerably exceeds the equivalent quantity of carbonic acid, necessary to render it soluble in pure water, and this fact affords a probable explanation of the character this water exhibits, when tested by colored papers."

The "upper spring" seems not to differ essentially from the lower. In sensible properties, it bears a close resemblance to it: but there is a peculiar sweetness of taste, which distinguishes it. The deposit around it is mostly of a dark blue color, while that of the lower spring is white. It rises about sixty rods east of the other, and is at an elevation considerably above it. The bed of sand, through which this water oozes, is about twenty feet, and the rock about thirty feet below the surface of the ground. One gallon from this spring, according to Prof. Hadley, of the institution of Fairfield, Herkimer County, New York, was found to contain the following substances, and nearly in the following proportions, viz.

| | | |
|---|---|---|
| Carbonic acid, | 5.6. | cubic inches. |
| Hydro-sulphuric acid, | 12. | " |
| Sulphate of lime, | 84. | grains. |
| " magnesia, | 10. | " |
| " soda, | 16. | " |
| Carbonate of lime, | 8. | " |
| Chloride of sodium, | 18.4 | " |

And a small quantity of other matter.

There are other springs in the neighborhood, but their qualities are essentially the same as those quoted. The geology of the vicinity is said to be bituminous shale, upon transition limestone. Iodine and bromine have not yet been detected in the constitution of these waters; but it is probable that no very accurate examinations have been made, with a view to their discovery; although Dr. Francis observes, that an analysis of these waters, which he caused to be made in 1832, did not afford satisfactory evidence of their containing iodine.

14. *A Treatise on Gems, in reference to their practical and scientific value. A useful guide for the Jeweller, Lapidary, Artist, Amateur, Mineralogist, and Chemist; accompanied by a description of the most interesting American gems, and ornamental and architectural materials.* By Dr. Lewis Feuchtwanger. New York, 1838.—The title of this work embraces a very correct idea of its contents. Dr. Feuchtwanger has collected a great amount of information, drawn from many sources, in addition to his own experience, both in regard to the scientific character, commercial value, history, and antiquity; not only of the gems, properly so

called, but of all substances, natural or artificial, which it has pleased the fancy of mankind to esteem as objects of personal ornament, and which are usually known by the name of precious stones. He gives a minute account of the preparation of pastes, or imitations of real gems, of the method of cutting and polishing all gems, and of the forms most suitable to enhance their natural beauty. The history of the diamond, the prince of gems, and by many esteemed a better standard of value than silver or gold, is drawn with much care, and is particularly interesting, viewed either as a scientific or practical account.

This book, taken in connection with that of Prof. N. F. Moore, of Columbia College, viz. "Ancient Mineralogy, or an Inquiry concerning the Mineral substances mentioned by the Ancients, &c." and noticed in this Journal, (Vol. 28, p. 188,) affords a very complete view of the history and antiquity of those gems and minerals which were known in the early periods of society.

Dr. F. has endeavored to Americanize his book, by giving an account of all the principal American localities of precious stones, and ornamental and architectural materials; with the hope of calling more attention to our internal resources of this nature. At the conclusion of the present treatise, it is announced that Dr. F. is to publish a "MINERALOGICAL TEXT BOOK, *for the use of schools, seminaries, and private students.* This latter work is intended not to be strictly philosophical, as it is a plain text book for the younger student, who wishes to be informed of the elementary principles, and how to collect, and to classify the minerals coming under his observation."

15. *Extreme heat at Cumberland, Md., communicated by the Editor's request.* To PROF. SILLIMAN—*Dear Sir:* In the afternoon of Saturday, the 28th of July, the thermometer in the piazza of Black's Hotel, in Cumberland, Md.,* about two o'clock, was at 102° of Fahr.; it gradually rose to 104°; from about 3 to 4 o'clock it fluctuated from 102° to 106°,—and at about 4 o'clock it rose to 107°, and then to 108°, where it remained at 5 o'clock. One of the gentlemen then removed it from its position against one of the pillars of the piazza in the shade, to one in the direct rays of the sun,—it almost immediately rose to 120°, the highest graduation of the tube, filled it entirely, and the ball was soon after burst. At Hancock, about 30 miles below, on the Potomac, at the same hour, the thermometer varied from 107° to 109°. You are yourself familiar with the position at Black's; it looks, I think, nearly north.

With great respect, your friend and servant,

B. B. HOWELL.

New York, Aug. 4, 1838.

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* Lat. 39° 58′ N. Long. 77° 33′ W.

16. *Evidences of diluvial currents—petrifactions—metallic models of shells.* To Prof. Silliman & Son: Gent.,—Herewith I send you specimens of the surface rock in this vicinity. The large slab, containing chert, was taken from the village of Black Rock, about four miles north of this city. The grooves at this locality, as determined by Mr. Haskins and myself, range, allowing for variation, N. 28° 12′ E.

You will perceive, that wherever a nodule of chert projects above the surface, a ridge of the softer limestone has been protected, in some measure, from friction, which invariably, at this locality, as well as at the Black Rock quarry, one and a half miles distant, point in a southerly direction. Some parts of the surface rock, where this slab was procured, present this phenomenon much more perfectly; the nodules of chert often having a semi-circular depression worn into the rock on their northern sides, opposite to the projecting ridge. I regret that such a specimen could not be procured, as the strata on which they occur are from one foot to one and a half feet in thickness.

Can proof be more conclusive, that these marks and scratches were produced by gravel stones and boulders, swept over the surface of the rocks by currents, tides, or waves, which flowed from the north?

I also send a smaller slab, somewhat polished. It was procured about half a mile further north, but as no marks appear on the surface, we could not determine precisely the course from which the water flowed.

At Black Rock quarry, where a large surface has been uncovered for the purpose of procuring materials to construct the breakwater, outside of Buffalo harbor, the grooves range N. 15° 32′ E. The friction there has been equally powerful; but as the rock consists almost entirely of chert, the ridges pointing towards the south are less prominent.

I also put into the box a piece of weathered chert, from which the carbonate of lime has been decomposed. The workmen here sometimes call this "chawed stone." I add also some madreporites, and metallic casts of two species of terebratulites, of which I have been able to procure but single specimens.

Hoping that the box and its contents will prove acceptable, I remain, yours truly, &c. Geo. E. Hayes.

The box was highly acceptable, especially as the proofs of powerful and lasting diluvial action are decisive on the slab of limestone, as well as on the pieces which we have recently seen at Buffalo, in the possession of Mr. Haskins and Dr. Hayes.—Editors.

17. *The American Almanac, and Repository of Useful Knowledge,* for the year 1839. Boston, Chas. Bowen. Vol. 10.—This valuable work, for the ensuing year, has been forwarded to us by its Editor, Mr. J. E. Worcester. To it is appended a general index of the last ten volumes,

which will render the valuable statistical information contained in them, very available. The astronomical department is still under the conduct of Mr. Paine, and is, as usual, able and accurate.

18. *Green Feldspar and Galena.*—The green feldspar of Beverly, mentioned in our last, was discovered by Prof. Webster, not by Dr. Cornelius, as stated, together with zircon, and described in the Boston Jour. of Philos. Vol. 1st. A vein of Galena has just been discovered at Dedham, Mass.

19. *Fossil Fishes in the red sandstone of New Jersey.*—Professor Gale, of the New York University, has found fossil fishes in the sandstone of New Jersey, near its western margin in Morris County. The existence of these fossils seems to have been long known to persons residing in the vicinity. The principal specimen obtained by Prof. Gale, appears to be a species of the *Palæoniscus*, of Agassiz, and is probably identical with one of the *Palæonisci*, found at Middletown, in the state of Connecticut.

20. *United States South Sea Surveying and Exploring Expedition.*—The squadron entrusted with the execution of this important national enterprise, sailed from Hampton Roads, Norfolk, Va. on the evening of Saturday, August 18, 1838. The results of this noble undertaking will, we doubt not, prove of the greatest value to the cause of science and to the nautical and commercial interests of the nation, and highly creditable both to the members of the expedition, and to the government which sends it forth. The officers of the various vessels, and the members of the scientific corps which accompanies them, are gentlemen of ample qualifications for the arduous and honorable duties assigned to them; and the auspices under which the expedition is finally dispatched, are highly propitious. The enterprise has excited a deep interest in the mind of the nation, and all embarked in it depart with the kindest wishes of their countrymen, for their prosperity, and for their safe return, in due time, to their kindred and their homes.

We annex an account of the vessels constituting the squadron, with a list of the officers and of the gentlemen of the scientific corps.

The *Vincennes*, is a first-class sloop of war, of 650 tons, commanded by *Charles Wilkes, Esq. Commander in Chief of the Expedition.* A light spar deck has been put on this ship, which gives her the appearance and some of the conveniences of a small frigate. Her battery is reduced to 8 guns, and she carries about 150 men. The *Peacock*, commanded by *William L. Hudson*, Esq. is a second-class sloop of war, of 600 tons, and of the same construction. She carries 130 men and 8 guns. The store-ship *Relief*, commanded by *A. K. Long*, Esq. is of 450 tons burthen, and carries 75 men and 6 guns. The brig *Porpoise*, commanded by Lieut. *Cadwallader Ringgold*, is of 200 tons burthen, and carries 65 men and 4 guns. The schooner *Sea Gull*, commanded by passed midshipman *J. W. E. Reid*, is of 110 tons, and carries 15 men. The schooner *Flying Fish*, commanded by passed midshipman *Samuel R. Knox*, is of 90 tons, and carries 12 men.

The following is a list of the officers, &c.

Vincennes.—Charles Wilkes, Esq. Commander in Chief; Thomas T. Craven, 1st Lieutenant; Overton Carr, Flag do.; Robert E. Johnson, 2d do.; James Alden, 3d do.; William Lewis Maury, 4th do.; James H. North, Master; Edward Gilchrist, Fleet Surgeon; R. R. Waldron, Purser and Special Agent; J. L. Elliot, Chaplain; John L. Fox, and John T. Whittier, Assistant Surgeons; George M. Totten, William Reynolds, William May, and Joseph P. Sanford, Passed Midshipmen; George W. Clark, Midshipman; Samuel Elliott, Acting Midshipman; William Smith, Boatswain; W. G. Bright, Gunner; William M. Laighton, Carpenter; S. V. Hawkins, Sail Maker; Benjamin Vanderford, Pilot; R. P. Robinson, Purser's Clerk.

*Scientific Corps.*—Charles Pickering and J. P. Couthouy, Naturalists; Joseph Drayton, Artist; J. Brackenridge, Assistant Botanist; J. G, Brown, Repairer of Instruments.

Peacock.—William L. Hudson, Commanding; Samuel P. Lee, 1st Lieut.; William M. Walker, 2d do.; Geo. F. Emmons, 3d do.; Oliver H. Perry, 4th do.; Thomas A. Budd, Master; J. Frederick Sickels, Surgeon; William Speiden, Purser; Silas Holmes, Assistant Surgeon; James B. Lewis, Passed Midshipman; Hunn Gansevoort, do.; Henry Eld, Jr. do.; George W. Harrison, do.; Wilkes Henry, Midshipman; Wm. H. Hudson, do.; Thomas G. Bell, Acting Boatswain; John D. Anderson, Acting Gunner; James Dibble, Acting Carpenter; —— Freeman, Sail Maker; William H. Insley, Purser's Clerk.

*Scientific Corps.*—James D. Dana, Mineralogist and Geologist; Titian R. Peale, Naturalist; Horatio E. Hale, Philologist; Francis L. Davenport, Interpreter.

Relief.—A. K. Long, Commanding; Robert F. Pinckney, Lieut.; A. L. Case, do.; Joseph H. Underwood, do.; James C. Palmer, Acting Surgeon; George T. Sinclair, Acting Master; Alonzo B. Davis, Passed Midshipman; Thomas W. Cummings, do.; James L. Blair, Midshipman; James B. Harrison, Captain's Clerk.

*Scientific Corps.*—William Rich, Botanist; Alfred T. Agate, Artist.

Porpoise.—Cadwallader Ringgold, Commanding; M. G. L. Claiborne, 1st Lieut.; H. J. Hartsein, 2d do.; John B. Dale, 3d do.; Charles T. B. Guillon, Assistant Surgeon; Augustus S. Baldwin, Acting Master; Simon F. Blunt, Passed Midshipman; George Colvocoressis, do.; T. W. Waldron, Clerk; Oliver Nelson, Acting Boatswain; Amos

Chick, Acting Carpenter; John Jones, Acting Sail Maker; William H. Morse, Purser's Clerk.

Schooner Flying Fish.—Samuel R. Knox, Passed Midshipman; George W. Hammersley, do.; Richard Ellis, Acting Master's Mate.

Schooner Sea Gull.—James W. E. Reid, Passed Midshipman; F. A. Bacon, Passed Midshipman; Isaac Percival, Pilot.

21. *Annals of Natural History, or Magazine of Zoology, Botany, and Geology.* Conducted by Sir William Jardine, Bart., P. J. Selby, Esq., Dr. Johnston, Sir W. J. Hooker, Regius Prof. of Botany, Glasgow, and Richard Taylor, F. L. S.—In Vol. 32 of this Journal we noticed, among other new Journals, the Magazine of Zoology, Botany, and Geology, conducted by the three first names in the above list; and our readers have since then been often reminded of it, by our frequent quotations from its pages. The companion to the Botanical Magazine has also become somewhat familiar to us, on this side the Atlantic, while the name of its conductor is here, as in the whole scientific world, inseparably associated with modern botanical science. It was with regret that we learnt, that neither of these valuable Journals could be sustained singly, from the want of sufficient encouragement to meet the expenses of publication. It is, therefore, we presume, with a view to mutual support, as well as concentration of talent and effort, that their editors have seen fit to unite them under a new name, and to alter the time of publication from six to twelve times a year. They have, likewise, associated with themselves Richard Taylor, Esq. under secretary of the Linnæan Society. We have not yet seen this new form of our former acquaintances, but there can be no doubt that it will sustain the same high position in its own departments, as each of the Journals of which it is composed did, previous to their union; and it would seem strange if it should not rise above it.

Presuming that our readers would be glad of early information on this point, we copy the contents of the first number, which was issued in March, from an advertisement which has reached us before the work itself. The price is 2*s.* 6*d.* per number.

*Contents.*—I. On a new Oscillatoria, the coloring substance of Glaslough Lake, Ireland. By James L. Drummond, M. D.—II. On the germination of Limnanthemum lacunosum. By Dr. Grisebach.—III. Contributions to the Natural History of Ireland. By William Thompson, Esq.—IV. On some new species of *Quadrupeds*, and *Shells.* By J. E. Gray, Esq.—V. On the Echinodermata. By L'Agassiz.—VI. On the Scottish Mollusca Nudibranchia. By George Johnston, M. D. —VII. Letters from Botanical Travellers: Mr. Cuming, Manilla; Dr. Schomburgh, Berbice; Gardner, Brazil.—*Bibliographical notices*:— Agassiz, Poissons d'Eau douce d'Europe; Plantes Cryptogames de France, par H. J. Desmazières; Das System der Pilze von L. Nees von Esenbeck und A. Henry.—*Societies* :—Proceedings of the Linnæan Society; Royal Society of Edinburgh; Entomological Society; Botanical Society; Zoological Society.—*Miscellaneous.*

22. *Analysis of Gmelinite or Hydrolite*; by A. Connell, Esq., F. R. S. E., &c. (Jameson's Journal, No. 48, p. 360.)—Mr. Connell finds that 17.67 grs. of this mineral from the County of Antrim, in Ireland, are composed exclusive of water of

| | |
|---|---|
| Silica, - - - | 8.581 |
| Alumina, - - - | 3.19 |
| Lime, - - - | 1.084 |
| Soda, - - - | .682 |
| Potash, - - - | .069 |
| Oxide of iron, - - - | .02 |
| | 13.626 |

To determine the quantity of water, a portion of the crystals was ignited in a platinum crucible, and charcoal fire, when the loss of weight amounted to 21.66 per cent. We have thus, in 100 parts of the mineral,

| | | Oxygen contained. | |
|---|---|---|---|
| Silica, - - | 48.56 | | |
| Alumina, - - | 18.05 | 8.430 | 3 |
| Lime, - - | 6.13 | 1.721 | |
| Soda, - - | 3.85 | .984 | 1 |
| Potash, - - | .39 | .066 | |
| Oxide of iron, - | .11 | | |
| Water, - - | 21.66 | 19.253 | 7 |
| | 98.75 | | |

It sufficiently appears, both from the analysis of Vauquelin* and from that here detailed, that this mineral is nearly allied to chabasite, in a chemical point of view, as according to Mr. Haidinger,† it is crystallographically; and it is not impossible that if analysis applicable to different localities were repeated and sufficiently extended, the chemical formula for chabasite might be found to embrace gmelinite. It does not, however, apply to the above analysis, and still less to those of Vauquelin.

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* Edinb. Jour. Science, II, 262.

| | Montecchio Maggiore. | Castel. |
|---|---|---|
| Silica, - - - | 50.00 | 50.00 |
| Alumina, - - - | 20.00 | 20.00 |
| Lime, - - - | 4.50 | 4.25 |
| Soda, - - - | 4.50 | 4.25 |
| Water, - - - | 21.00 | 21.00 |
| | 100.00 | 98.50 |

† Mohs's Mineralogy, fig. 195.

The formula indicated by the above result is, $(CNK)S^3+3Al\ S^2+7Aq$; and it may be noticed, that while this formula indicates one atom of silica and one atom of water, *more* than that for chabasite, the formula which analysis of levyne, a mineral also nearly allied to chabasite in a chemical view, suggested, shewed one atom of silica and one atom of water, *less* than in chabasite;[*] and that in gmelinite, bisilicate of alumina is associated with tersilicate of lime and alkalies; in chabasite with bisilicate; and in levyne with silicate of these bases, as appears from the formulæ:

$(CNK)S^3+3Al\ S^2+7Aq$. Gmelinite.
$(CNK)S^2+3Al\ S^2+6Aq$. Chabasite.
$(CNK)S\ +3Al\ S^2+5Aq$. Levyne.

Mr. Connell continues to remark, I have much less expectation that the chabasite formula will ever be found to embrace levyne, because the proportion of silica and that of alumina, actually found in the latter mineral, differs in a marked manner, and in opposite directions from those in chabasite; while in gmelinite, the difference is much less considerable, although still excluding the chabasite formula.

23. Prof. Owen *on the Fossil Animals collected by* Mr. Charles Darwin, (from the Zoology of the voyage of H. M. S. Beagle during the years 1832 to 1836. Part first. Fossil Mammalia.)—"It is remarkable that all the fossils collected by Mr. Darwin belong to herbivorous species of mammalia, generally of a large size. The greater part are referable to the order which Cuvier has called Edentata, and belong to that subdivision of the order (*Dasypodidæ*) which is characterized by having perfect and sometimes complex molar teeth, and an external osseous and tessulated coat of mail. The megatherium is the giant of this tribe, which at the present day is exclusively represented by South American species, the largest (*Dasypus Gigas, Cuv.*) not exceeding the size of a hog. The hiatus between the living species and the megatherium is filled up by a series of armadillo-like animals, indicated more or less satisfactorily by Mr. Darwin's fossils, some of which species were as large as an ox, others about the size of the American Tapir. The rest of the collection belongs, with the exception of some small Rodents, to the extensive and heterogeneous order Pachydermata; it includes the remains of a mastodon, of a horse, and of two large and singular aberrant forms, one of which connects the Pachydermatous with the Ruminant order; the other, with which the descriptions in the following pages commence, manifests a close affinity to the Rodent order."

The first fossil animal mentioned by Professor Owen is named *Toxodon Platensis*, which he describes as a gigantic extinct mammiferous animal, referable to the order Pachydermata, but with affinities to the

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[*] Lond. and Edinb. Phil. Jour., V, 40.

Rodentia, Edentata, and herbivorous Cetacea. From the dimensions of the cranium, it would appear that the Toxodon Platensis must have been as large as the colossal megatherium. The next extinct fossil animal described is named *Macrauchenia Patagonica*, which is a mammiferous quadruped, referable to the order Pachydermata, but with affinities to the Ruminantia, and especially to the Camelidæ. This is a very beautiful piece of investigation, and proves the singular address and skill of our author,—for, furnished only with a few bones of the trunk and extremities, without a fragment of tooth or of cranium, to serve as a guide to the animal's position in the zoological scale, he has been able to refer it to its place in the system.—*Edinb. New Phil. Jour. for April*, 1838.

24. *Presentation of the Wollaston Medal.*—The Wollaston Medal for the last year has been presented to *Prof. Richard Owen* by the Geological Society of London, on which occasion the President, Mr. Whewell, expressed himself in the following terms:

"Mr. Owen,—I have peculiar pleasure in presenting you with this medal, awarded to you by this Society, for your services to fossil zoology in general, and in particular for the description of the fossil mammalia collected by Mr. Darwin. I trust it will be a satisfaction to you to receive this our testimony of the success with which you have cultivated that great science of comparative zoology, to which you have devoted your powers. I trust it will add to your satisfaction, to consider, that the subject which we more peculiarly wish to mark on this occasion,—the study of fossil zoology, is one to which the resources of your science were applied, while the subject was yet new, by that great man, John Hunter, whose museum and whose reputation are so worthily assigned to your care. I trust also that this medal, thus awarded to you, at the outset, if I may so say, of an enlarged series of investigations, will convey to you the assurance, that in your progress in such researches, you carry with you our strong interest in your endeavors, and our high esteem of your powers and your objects; and will convince you, that in all your successes, you may reckon upon our most cordial sympathy in the pleasure which your discoveries give."—*Ed. New Phil. Jour. April*, 1838.

25. *On the Rapidity of Motion in Railway Cars which is consistent with safety.*—*Mr. Sang*, F. R. S. E. &c. &c. of Edinburgh, in a late number of Jameson's Journal gives as the results of his observations on the Liverpool and Manchester Railway, that a speed much greater than the present twenty five miles per hour, may be used with safety. The question is, whether with a velocity of three or four times the usual rates, the engineer can preserve perfect command of the powerful locomotives required. Mr. Sang remarks, that "with the velocity of twenty five miles an hour, even when exposed to the current of air, there was not

the slightest approach to any feeling that would lead me to suppose that four or five times the velocity would disable the engineer from directing and managing the train. Such was the result of my own observations, and it was fully borne out by the experience of the men. I may cite two instances of common occurrence. When the train arrives at the foot of of one of the inclines, the banking engine follows to assist it up. Now one would be apt to imagine, that for the purpose of attaching the new engine, the train would stop, or that if it did not, there would be a concussion when the banking engine comes in contact. So completely however are these powerful engines under the control of their directors, and so well are they managed, that a passenger in the train who is not aware of what is going on from ocular perception, is altogether unconscious of any change. I frequently watched this operation, but on no occasion could I perceive the slightest shock, even when situated only one or two carriages from the end of the train.

"On one occasion the banking engine had got before us on the incline; as the hooking of it on in such a situation was a much severer test of the skill with which matters are managed, I attended closely to the operation; we were going fully twenty five miles an hour. The banking engine gradually slackened its rate and allowed the train to gain upon it, until it could be hooked on,—that done, more steam was given and we proceeded with its assistance, yet not the slightest shock was felt in the train. These facts are sufficient to show, that much greater rapidity is practicable so far as the power of managing the apparatus is concerned. As to velocity itself, I made some observations. Twenty five miles an hour is not so very rapid; over and again I saw bees not merely keep pace with us but fly round and across the coach, and that not by help of any current of air which might be supposed generated, but at several feet distance from the train. At times two specimens of the *Libellula grandis* kept up with us over half a mile; while the smaller birds, such as the linnet, were unable to cope with the steam. One I almost caught, which while flying with all its might, remained opposite to the window for a few seconds. If a rail road be regarded only as a means of communication between two distant towns, I should have no hesitation in saying that a rate even of one hundred miles per hour could be maintained with perfect safety to the passengers; but it is different if passengers have to be let out at stations along the line, for then the trouble and expense of stopping the trains comes to be considered. An average of about three minutes is consumed by each stop, including the slackening and regaining of speed before and after stops."

26. *On the Gases contained in the Blood, and on Respiration;* by M. G. MAGNUS.—M. Magnus remarks that it remains a question whether carbonic acid is formed in the lungs by the oxidizement of a part of the

carbon in the blood by the action of the air, or whether venous blood, when it reaches the organs of respiration, contains carbonic acid ready formed, which is merely separated from it.

M. Magnus passed hydrogen gas through a solution of potash to deprive the gas of any carbonic acid which it might contain, and when it gave no precipitate with lime water he passed it into the blood of a healthy man; the gas afterwards made to go through lime water gave a plentiful precipitate of carbonate of lime. Azotic gas similarly employed produced a like effect; and M. Magnus concludes, from these experiments, that carbonic acid exists ready formed in the blood, and consequently that it is not formed in the lungs. Carbonic acid was also separated from blood by means of the air-pump.

By using Liebig's apparatus M. Magnus found that blood contained about one fifth of its volume of carbonic acid gas, and when it had been kept twenty four hours, without emitting any bad smell, the quantity was larger. The results were confirmed by employing atmospheric air instead of hydrogen gas.

M. Magnus then ascertained the nature and proportions of all the gaseous contents of the blood. He found that one hundred volumes of the arterial blood of a horse yielded

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| Carbonic acid gas, - - - - | 4.32 vols. |
| Oxygen, - - - - | 1.52 " |
| Azote, - - - - | 2. " |
| Total, | 7.84 vols. |

The venous blood of the same horse, drawn four days afterwards, gave

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| Carbonic acid gas, - - - - | 4.29 vols. |
| Oxygen, - - - - | 1.12 " |
| Azote, - - - - | .54 " |
| Total, | 5.95 vols. |

The arterial blood of the calf contains more, and the venous blood less oxygen, than that of the horse.

M. Magnus observes, that these experiments, and others which we have not copied, appear to show that the gases contained in the blood of the animals, amount to about one eighth or one tenth of the quantity employed. He admits however that the experiments are not absolutely precise, because they were not all continued the same length of time, &c. But he observes, that as the proportions between the oxygen and carbonic acid are invariably the same, these results may be regarded as satisfactory.

With regard to the theory of respiration, all experimentalists agree as to the reciprocal proportions between the carbonic acid expired and of the oxygen absorbed; while however some of them are of opinion that those quantities are always equal, as must happen if the oxygen gas were employed merely in the formation of carbonic acid in the lungs, there are chemists whose results show that more oxygen is inspired than carbonic acid expired. Messrs. Allen and Pepys observed that this was constantly the case when the same air was repeatedly respired.

M. Magnus adds, that this fact, so inexplicable by other theories, is an immediate consequence of the hypothesis founded on the law, that a liquid holding a gas in solution parts with it when it comes in contact with another gas.

Another circumstance noticed by Messrs. Allen and Pepys is as inexplicable as the preceding, namely, that by the respiration of oxygen, or by a mixture of oxygen and hydrogen, azotic gas is constantly expired, the volume of which is proportional to the bulk of the animal; this proves that it cannot at all be attributed to the air.

It now remains to be shown that the carbonic acid extracted from the blood is in sufficient quantity to account for the whole of that which the lungs expire. The results obtained on this subject are discordant; those of Messrs. Allen and Pepys evidently exceed what they should be; for Berzelius has shown, that if correct, it would require six pounds and a quarter of solid nourishment in twenty four hours to produce the quantity of carbon consumed.

Taking then the results obtained by Davy as a mean of those of Lavoisier, Allen and Pepys, although perhaps a little too high, we shall have thirteen cubic inches as the quantity of carbonic acid gas expired by a man. If it be further admitted, that at each pulsation of the heart an ounce of blood arrives at the lungs, seventy five pulsations in a minute would convey five pounds of blood in the same time. This is the minimum quantity which can be admitted; for it is very probable that five pounds of blood pass through these organs every minute: these five pounds produce thirteen cubic inches. It has been already mentioned that the blood contains at least one fifth of its volume of carbonic acid; and as a pound is equal to twenty five cubic inches, each pound of blood would contain at least five cubic inches of carbonic acid. It will be observed that no circumstance opposes the proposed theory, hence the experiments prove, that the quantity of carbonic acid contained in venous blood, is more than sufficient to furnish the quantity expired.—*Journal de Chimie Médicale, Nov.* 1837.—*Lond. and Ed. Phil. Mag. March,* 1838.

27. *Eighth Meeting of the British Association for the Advancement of Science.*—The eighth meeting of this Institution was held at Newcastle during the week from August 20 to August 26, 1838, Sir John F. W. Herschel presiding. The number of members was larger than at any former meeting. The Report of the doings of this meeting occupies 200 columns of the London Athenæum, and contains a large amount of scientific information, some of which we intend to transfer to the pages of our next number.

# THE
# AMERICAN
# JOURNAL OF SCIENCE, &c.

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## Art. I.—*On the Courses of Hurricanes; with notices of the Tyfoons of the China Sea, and other Storms;* by W. C. Redfield, Memb. of Conn. Acad. of Arts and Sciences, Corr. Memb. of U. S. Naval Lyceum, the Albany Institute, &c.

[Written for the London Nautical Magazine.]

In a communication published in the Nautical Magazine for April, 1836, I attempted to correct some errors which had obtained currency in nautical books, relating to the supposed erratic character and progress of the hurricanes of the Atlantic. These corrections were accompanied by a summary statement of the results which my inquiries on this subject had appeared to establish. These results were first published in 1831, but have been further generalized and supported in subsequent papers. Their striking uniformity has been considered as indicating the operation of a general law, controlling the action and progress of these violent storms. The incipient essay now referred to, was illustrated by a chart containing delineations of the routes of two of these storms.* To my communication in the Nautical Magazine was likewise appended a chart, on which were delineated the routes and daily progress of some ten or twelve of these gales,

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* Silliman's Journal for April, 1831, Vol. XX, p. 17—51. See also Vol. XXI, p. 191—193; Blunt's Am. Coast Pilot, 12th edition, July, 1833, p. 626—629; Silliman's Journal, Vol. XXV, p. 114—135; Vol. XXVIII, p. 310—318; XXXI, p. 115—130; XXXIII, p. 50—65 & 261—265; Jour. Franklin Inst. Vol. XIX, Feb. 1837, p. 112—127; Am. Coast Pilot 13th edit.; Jameson's Edinb. Jour. Feb.—April, 1838.

The writer had never contemplated the publication of any of the observations which he had incidentally been led to make upon storms, till within a few weeks of the time when the earliest of the above papers was sent to the press; when he was induced by the suggestions of his friend Prof. Olmsted, to attempt a which had been remarkable for their violence, and which were selected as illustrations of the general course and whirlwind character of many other storms, relating to which similar information had been obtained.

The favorable attention with which these statements have generally been received, together with the spirit and professional zeal with which the subject has been discussed in the pages of the Nautical Magazine, have seemed to invite a more detailed exhibition of the numerous facts which have claimed attention in the progress of my inquiries. Being informed, however, that Lieut. Col. Reid, of the Royal Engineers, had engaged in the investigation, with the design of publishing a more full exhibition of the facts than had yet been offered, I most willingly awaited the issue; being fully persuaded, that whatever doubts or difficulties might remain with those who had not thoroughly examined the subject, would not fail to be dispelled by his enterprising and judicious labors. The highly valuable work of Col. Reid, on the law of storms, is now before me; and I cannot but express my commendation of the talent and research by which he has so ably and satisfactorily exhibited the true natural system of hurricanes, and my acknowledgments, also, for the honorable and very flattering manner in which he has noticed my previous labors.

The mass of evidence and the numerous illustrations exhibited by Col. Reid, have happily left but little for me to attempt on the present occasion; and I proceed, Mr. Editor, to notice in a brief manner some few of the topics which your anonymous correspondent, under the signature of "Stormy Jack," has discussed in your pages; and whom, as the subject has now become more generally interesting, your readers will hope to meet under his own proper signature.

This writer appears, at an earlier period, to have assumed the hypothesis that the hurricanes of the inter-tropical latitudes originate in the *variables* or calm latitudes, which border upon the exterior limit of the trade winds. But in the reports of Lieut. James of H. M. Steam Packet *Spey*, and in other accounts,

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statement of his observations; and it is owing chiefly, perhaps, to this cause, that several redundancies, and some suggestions on collateral points, require to be expunged from that paper. This explanation is thought to be due to those readers who are now referred to the first named communication in Silliman's Journal for 1831, but need not be applied to the conclusions or opinions which have been advanced in the subsequent papers.

he thinks he finds evidence of a northerly or variable course, in the Barbadoes hurricane of 26th July, 1837; and also of a variable or northeastern course, in the Antigua hurricane of August 2d, 1837; or at least of a lateral movement or oscillation, in the course of these hurricanes.* He also suggests that hurricanes may alternately dilate and contract during their course.

The inquiries of Col. Reid, aided by his excellent charts and delineations, appear to have done much towards settling these questions, so far at least as relates to the particular storms referred to by your correspondent; and it may be observed, that in tracing the course or track of a storm, we must be governed by its regular geographical developments or progress, rather than by any inductions from the directions and changes of the wind at a given place, grounded on the known whirlwind character of these storms. It is true that these inductions, if carefully made, will commonly harmonize, with wonderful accuracy, with the actual course or path of the storm; but there are various sources of error, which may at times mislead us in our deductions, when made from a limited number of observations; some of which may here be cursorily noticed.

1. The reported observations are not always correct as to the *point of compass* from which the wind blows, and the changes which it exhibits, during the storm. This is not unfrequently the case with the reports of unpractised observers; or with observations made in the gloom of night; or in the tumultuous crisis of the hurricane, when the whole energies of the seaman are directed to his more immediate duties, and the preservation of his ship; and when in the darkness and turmoil of the storm, the swinging of the ship may sometimes be mistaken and reported for the irregular veering of the wind. Verbal or typographical errors, will also have sometimes occurred in the reports which are under consideration; and in some localities, an important difference between the magnetic and the true points of direction, is frequently confounded, or unnoticed.

2. The inductions in question are usually made on the theory of an exact circle in the course of the winds, which in large storms, and for practical purposes, is, in most cases, sufficiently accurate. But it sometimes happens, that the higher portions of the storm, overrun the inferior portions, and reach the surface in

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* See Nautical Magazine for January, 1838, pp. 35—40.

advance of the main storm; thus presenting the wind, for a few hours, in a direction not accordant with that exhibited by the main body of the storm. It may also be added, that in the most violent of these storms, it is at least probable, if not certain, that the course of the surface wind is spirally inward, approximating gradually towards the center of the storm.

3. At stations within the tropics, the changes of wind during the passage of the hurricane, are sometimes known to *exceed* those which pertain to the passage of a regular circuit of wind; these changes sometimes running through the entire circuit of the compass, and even more. Again, they have been known to shift *back and forward*, in alternate and fitful changes, when near the crisis of the storm. These phenomena, so far from disproving the rotative character of these gales, only prove something more, and afford at least probable evidence, in support of one or both of the following positions, viz. 1. That high land, and other obstructions, often produce sudden and fitful gusts and changes in these violent winds. 2. That, in accordance with our observations of minor vortices, the axis of rotation is often impelled, excentrically, around a smaller circuit, in the interior of the advancing storm.

4. In the northern intertropical latitudes, the recession or departure of the southeastern limb of the storm, appears to be followed, not unfrequently, by strong squalls or gusts from southeast, this being the true course of the general trade wind that determines the track of the storm. These gusts or squalls, if taken for the regular action of the hurricane, may occasion erroneous deductions in regard to the course of the storm.

5. In the latitudes near the exterior limits of the trade winds, the change which here occurs in the course of the storm, produces apparent irregularities or anomalies in the series of changes presented by the wind. Owing to this cause I was misled to some small extent in my estimate of the path of the first August hurricane of 1830, as delineated on my first published chart, with an irregular deflection of the curve on the coast of South Carolina, which was predicated, in part, on the wind setting in at northeast at Charleston, and veering to southeast as the storm became more severe.

6. At stations apparently within the regular track of the storm, there will sometimes be an absence of violent wind; or, the vio-

lence will pertain to only one of the phases which the storm presents, in its regular course over such locality. This may usually be accounted for, by the interposition of land within the course of the immediate circuit which the wind is found to pursue; and this result is perhaps most obviously exhibited in the South Atlantic or in the Southern Ocean, near the Cape of Good Hope, where the barometric column, not unfrequently, subsides and commences rising, before the full violence of the gale takes effect. The barometer, however, appears always to indicate the true extent and path of these whirlwind storms; and I have found no good grounds to infer, that a hurricane contracts in the width of its path, while sweeping upon the surface of an open sea.

7. Another source of apparent irregularity in the changes of wind in these storms, arises from the interposition of one storm upon the path of another, in their passage through the temperate latitudes. Col. Reid has shown something like this in the hurricane which overtook the *Castries*, August 24th, 1837, which was evidently impinging upon the path of the great hurricane which had previously swept along the American coast. That of the Castries appears to have pursued a course similar to the hurricane of October 1st, 1830, as delineated on my first published chart; thus advancing, by a shorter course, into the path of the larger hurricane, and probably with a greater progressive velocity. Col. Reid justly urges the influence of these causes in producing the irregular winds of the higher latitudes. Of the influence of such interposition in apparently arresting or modifying the regular development of a storm while in progress, I have for many years been convinced; but it is due to Mr. Espy, of Philadelphia, to mention, that, so far as I know, he was the first to publish the suggestion.*

In tracing out the path of hurricanes, we justly discard all theory; and as the information obtained of their course and extent is necessarily limited, and is acquired at different and uncertain periods, our delineations are, therefore, necessarily subject to minor errors and to subsequent corrections. Such corrections, I have ever found to be in favor of the uniform rotation and regular course of progression, which have formerly been described. It is probable, therefore, that the narrowed track, and somewhat deflected courses, near the windward islands, of the Barbadoes hurricane of July 26, and of the Antigua hurricane of August 2d, 1837, as laid down by Col. Reid, will ultimately prove to have been more symmetrical;* and that the westerly recurvation of the track of the latter storm, across the shores of Georgia and Florida, to meet the case of the gale at Pensacola, will give place to a regular continuation of the track in a northeasterly direction. Was the gale at Pensacola, on the 7th or 8th of August, an offset from the Antigua hurricane? or will it not prove to have been another storm?

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* Journal of the Franklin Institute, Vol. xviii, October, 1836, p. 239.

Although I deem it probable, Mr. Editor, that your correspondent will find occasion to abandon his former views of the supposed lateral motion of the main body of the hurricane, as well as its alternate contraction and dilatation, yet these views appear to be sometimes applicable, or, at least, partially so, to the *axis* or *nucleus* of the great whirling stratum which constitutes the hurricane. In the columnar whirlwinds, or water-spouts, also, these contractions and dilatations of the diminished portion which sweeps upon the earth's surface, are often made sufficiently evident. The suggestions of your correspondent, therefore, are very far from being unsuited to the inquiry, and it is hoped that he will continue to bestow his attention on such facts relating to these storms, as may aid us in gaining further light upon the subject. For his commendations of my imperfect labors, he is desired to accept my acknowledgments. In the further progress of the investigation, it is believed that he will find reason to abandon all reliance upon 'rarefactions' or 'local disruptions,' in the great aerial ocean, as causes of the origin or progress of these great storms.

## *Hurricanes of* 1838.

Two hurricanes of the present season, (1838,) appear to invite our investigation;—that of the middle of June, in the North Atlantic, and also that which swept the American coast, from Florida to Newfoundland, in the early part of September. Those who have zeal for the undertaking, will find the inquiry both interesting and instructive.

## *New Jersey Tornado of* 1835.

At the late meeting of the British Association, when Col. Reid's paper on storms was under discussion, Prof. Bache of Philadelphia, very properly referred to the opposing theory of Mr. Espy, of that city, and stated, also, that in his own survey of the track of the water-spout, or tornado, which passed across the State of New Jersey in June, 1837, he had made observations which appeared to accord with Mr. Espy's theory of storms; and that he had found no evidence of a whirling motion at the surface of the ground, such as Col. Reid had ascribed to water-spouts and hurricanes. This view of the case Prof. Bache had also supported in an able paper on the phenomena of that tornado. I deem it proper to state here, that having also examined the track of the New Jersey tornado, within a few days of its occurrence, and having twice repeated the examination, at later periods, I have observed on each occasion, numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the vortex at the surface of the ground; and further, that the direction of this rotation was *towards the left*, as in the North Atlantic hurricanes;—a result which I had not previously expected, as it appeared probable that the direction of rotation, in these small whirlwinds, must be entirely accidental. This leads me to notice the only point, perhaps, on which my inquiries have led to a result differing from that obtained by Col. Reid; for in many cases of this sort, since examined, I have found the course of rotation to be uniformly towards the left.

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* Reid on the Law of Storms, Charts V. and VI.

Perhaps I should add further, that having also examined with some care, the reports of the meteorological committees at Philadelphia, made through Mr. Espy, their chairman, and also the meteorological essays of this gentleman, I have not been able to find evidence which disproved the rotation of a violent storm, or that established a course of wind from all sides of a storm directly towards its centre, in accordance with his theory; but, on the contrary, an analysis of the evidence which Mr. E. has adduced, together with the additional facts which I have been able to obtain, has appeared to contravene his conclusions. A valuable statement of facts relating to the snow storm which visited Pennsylvania and other states on the 17th and 18th of March last, drawn up by Mr. Espy, has recently been published by the Philadelphia committees.* Should the facts contained in this paper be adduced in favor of Mr. Espy's theory, I would only say, that in this, as in some of the former cases, the field of action of the whirlwind storm will have been in part mistaken. I would also remark, that the points at issue, do not relate to the common and often irregular winds, which, in different localities, accompany a general fall of rain or snow; or which sometimes attend the progress of a whirlwind storm, exterior to its limits.

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* See Journal of the Franklin Institute, Vol. XXII, 1838, pp. 161—175.

## *Test of Mr. Espy's Theory.*

The truth or error of Mr. Espy's theory may be ascertained by a very simple test. The hurricanes in the West Indies are known to move towards the W. N. W., nearly. Now, if this theory be true, at those islands which are in the centre of the storm's path, and where the gale is of the greatest duration, the wind will set in at about W. N. W., or exactly opposite to the course of the storm, and when its centre has passed over, will shift suddenly to E. S. E., and continue violent in this quarter till the storm is over. But if the gale be a whirlwind, as the facts seem to show, the wind at such places will set in at about N. N. E., and in the middle of the gale will shift nearly to S. S. W.,—the wind varying from these points, and veering more gradually, on either side, in proportion to the distance from the centre of the storm's track. That this corresponds, mainly, to the facts of the case, will hardly be doubted by those who institute the inquiry.

The same test may also be applied to these storms as they move in a N. E. direction along the shores of the United States; where, according to Mr. Espy's views, the gale, on the centre of its path, should blow, for the first part of its duration, from about N. E.; and in the second half, from nearly S. W.* But all our inquiries serve to show, that the gale is violent at N. E. only on the northern portion of the track of the tempest, and that the usual changes from this direction, are not sudden, and to an opposite point of the compass; but, instead thereof, we observe a gradual veering, by the north, to the northwest.

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* Some storms, as Mr. Espy has also acknowledged, are interrupted in their development by the near approach of another storm. Care must be taken, therefore, not to mistake the N. E. wind of a storm whose northwestern limb is thus intercepted by a bordering storm, and which hence is sometimes followed by the natural current of air from the S. W. quarter, for the changes that pertain to the centre of the gale. This error is easily avoided by extending the field of inquiry, and by a due attention to the indications of the barometer.

### *Tyfoons of the China Sea.*

It can hardly be doubted that the general course which is pursued by hurricanes, is the same as that of the general mass of atmosphere or winds by which they are surrounded, and of which they form an integral portion. It becomes, therefore, a point of some importance in meteorology, to ascertain the true course of the hurricanes or tyfoons of the Asiatic seas. Should this course prove to be in conformity with the existing monsoons, this would be in accordance, it is believed, with the analogies in the tropical latitudes of the Atlantic; at least, if we have regard to the entire stratum of winds which lies below the common height of the clouds. But if the general course pursued by these storms, be the very same with those of the corresponding latitudes of the Atlantic, in which there are no monsoons, it may serve to show that the westerly monsoons, which are opposed to the course of the regular trade winds, consist only of a misplaced or minor stratum of current, which forms a thin layer of surface wind, less general than that of the regular trades, and which is therefore inefficient in opposing the progress of a great hurricane;—the latter being impelled by the stronger and more general current of the regular trade wind; which is supposed to overlie, at all times, the stratum of misplaced current which forms the westerly monsoon.

These remarks will apply equally to the monsoons of both north and south latitude. Col. Reid has been fortunate in obtaining full evidence of the opposite recurvation of a hurricane in south latitude, in open sea, and during the prevalence of the northwest monsoon; a result which can hardly be too highly valued. This storm, however, (Culloden's hurricane, of March, 1809,) was encountered to the southward of the limits of the northwest monsoon in the Indian ocean; but the hurricane of the Albion, noticed by Col. Reid, was exposed to the full influence of this monsoon. It becomes important, therefore, to ascertain its path, in order that the influence of the monsoon upon its course may be duly appreciated; and we hope that its path may yet be ascertained.

In regard to the northern hemisphere, Col. Reid has given us notices of several hurricanes or tyfoons in the Asiatic seas, with no indications of a course different from those in the North Atlantic. The following generalization, grounded on independent evidence, was published by the writer in 1833.* "The tyfoons and storms of the China sea and eastern coast of Asia, appear to be similar in character to the hurricanes of the West Indies and the storms of this coast, [United States,] when prevailing in the same latitudes." This remark was made with special reference to both the rotative and progressive directions of these storms. One of the tyfoons noticed by Col. Reid, that of the *Raleigh*, which visited Canton, on the 5th and 6th of August, 1835, has been adduced, however, by the correspondent of the Nautical Magazine, as holding its course towards the southwest.† As this tyfoon had previously attracted my attention, it will now be made the subject of our examination.

### *Raleigh's Tyfoon of* 1835.

The facts which have been chiefly relied on for establishing a southwestern course for this gale, are contained in the report of H. M. S. Raleigh, which was overset and disabled in this gale, in the China Sea, when under bare poles: which report I have as follows:

"*H. M. Brig Raleigh*. Aug. 1, 1835.—Working out of Macao Roads.—At noon, east end of Grand Ladrone, E. ½ S.—Aug. 2d, at noon, S. E. end of Formosa N. 85 E., 340 miles: fine weather all day.—Aug. 3d, at noon, S. end of Formosa N. 82¼ E., 252 miles. Fine weather all day.—Aug. 4th, 10h. 20m. a. m. close reefed topsails and courses:—12h. 30m. p. m.—barometer fell from noon $\frac{16}{100}$: took in mainsail and foresail;—at 1h. 30m. got all snug; vessel going through the water between 3 and 4 knots; barometer 29.40, falling;—at 7h. 30m. wind veered to N. N. E. and tyfoon commenced;—at 8 p. m. barometer 29.36, falling;—8h. 30m. tyfoon increasing;—10 p. m. close reefed fore trysail and set it;—tyfoon veering to E. N. E. with a heavy sea;—at midnight tyfoon increasing; barom. 29.04, falling.

"*Aug. 5th.*—3 a. m. tyfoon veering round to E. S. E., still increasing in violence;—6h. 30m. barometer 28.25;—8 a. m. tyfoon increasing;—9h. 30m. a. m., if possible blowing heavier, *ship went over*:—In this awful situation ship lay for about 20 minutes;—9h. 50m. lower masts went by the board and ship righted with seven feet water in her hold; barometer did not fall lower;—at noon tyfoon moderated a little;—at 6 p. m. tyfoon more moderate, with a heavy sea;—midnight, strong gusts of wind with heavy sea from south."—*Abridged from Canton Register of March* 14, 1837.

See also the log of the Raleigh, as it appears in Col. Reid's work, which contains a sketch, showing the position of the Raleigh, as given in the log, and illustrating the direction of the wind. Col. Reid has also given the position of a schooner, which encountered the tyfoon in lat. 18° 2′ N., lon. 115° 50′ E., of which I had previously received no account. I will now submit such evidence as I possess, in addition to the account furnished by the Raleigh; adding, also, a sketch and figure illustrating the course and progress of the tyfoon; and which was prepared and stereotyped some months since, in reference to furnishing an account of this hurricane.

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* American Coast Pilot, 12th edition, p. 629.

† See Nautical Magazine for May, 1837, pp. 303—306.

At *Macao*, where the tyfoon was experienced on the 5th and 6th, many houses were greatly damaged; also, many lives were lost in the inner harbor, and some vessels driven on shore. The direction and changes of the wind at Macao are not stated; but we are favored with the following valuable table of the state of the barometer during the period of the storm.

| h. | m. | | Barom. |
|---|---|---|---|
| "*August 5th.* | | | |
| 1 | 00 | a. m. | 29.47 |
| 2 | 30 | p. m. | 29.28 |
| 5 | 00 | " | 29.20 |
| 7 | 20 | " | 29.12 |
| 9 | 00 | " | 29.08 |
| 10 | 20 | " | 28.95 |
| 10 | 45 | " | 28.90 |
| 11 | 05 | " | 28.85 |
| 11 | 30 | " | 28.75 |
| 11 | 53 | " | 28.65 |
| *August 6th.* | | | |
| 0 | 15 | a. m. | 28.50 |
| 0 | 30 | " | 28.40 |
| 0 | 45 | a. m. | 28.30 |
| 1 | 20 | " *(lowest)* | 28.05 |
| 1 | 25 | " | 28.08 |
| 1 | 45 | " | 28.20 |
| 1 | 55 | " | 28.30 |
| 2 | 00 | " | 28.37 |
| 2 | 25 | " | 28.56 |
| 2 | 45 | " | 28.68 |
| 3 | 10 | " | 28.75 |
| 3 | 40 | " | 28.83 |
| 4 | 10 | " | 28.90 |
| 4 | 45 | " | 28.97 |
| 5 | 15 | " | 29.02 |
| 6 | 00 | " | 29.08 |
| 6 | 45 | a. m. | 29.12 |
| 7 | 45 | " | 29.20 |
| 8 | 15 | " | 29.21 |
| 8 | 45 | " | 29.23 |
| 9 | 30 | " | 29.27 |
| 10 | 25 | " | 29.30 |
| 11 | 00 | " | 29.34 |
| 2 | 00 | p. m. | 29.42, |

and continued rising to 29.65, at which point it usually stands during fine weather."*—*Canton Register*, *Aug*. 15.

This table affords in itself good evidence of the passage of the centre of the vortex near to Macao.

At *Canton*, (60 miles north of Macao,) the tyfoon began on the evening of the 5th, after three or four days of very hot weather, with northerly winds, and continued throughout the night and the next day. Its violence was greatest about two o'clock on the morning of the sixth. The following is an account of the state of the barometer and winds at Canton:

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* This relates to "fine weather" of the S. W. monsoon; the mean of the barometer for July and August being, at Canton, 0.40 in. *lower* than for December and January, in the N. E. monsoon. This barometer at Macao appears to stand about 0.15 or 0.20 inch lower in its adjustment than that used at Canton for the reports in the Canton Register, the mean of which for five years is 30,027. Many, if not most of the common ship barometers, stand too low in their adjustment.

*August 4th.*

| | | | | | |
|---|---|---|---|---|---|
| 9 a. m. | barom. | 29.79 | Wind | N. W. | Fine weather. |
| 4 p. m. | “ | 29.70 | “ | N. by W. | Moderate breeze. |

*August 5th.*

| | | | | | |
|---|---|---|---|---|---|
| 9 a. m. | “ | 29.62 | Wind | N. and N. W. | Fair Weather. |
| 4 p. m. | “ | 29.54 | “ | unsettled—Rain and fresh breeze. | |
| 12 p. m. | “ | 29.37 | “ | N. blowing hard and in heavy gusts. | |

*August 6th.*

| | | | | | |
|---|---|---|---|---|---|
| 5 a. m. | “ | 29.34 | Wind | N. E. | blowing hard with heavy rain. |
| 9 a. m. | “ | 29.51 | “ | S. E. | “ “ “ |
| 11 a. m. | “ | 29.58 | “ | S. E. | blowing hard,—moderating. |
| 5 p. m. | “ | 29.70 | “ | S. E. | “ |
| 11 p. m. | “ | 29.85 | “ | S. E. | “ |

*August 7th.*

| | | | | | |
|---|---|---|---|---|---|
| 8 a. m. | “ | 29.94 | Wind | S. E. | Cloudy.—*Compiled from the Canton Register.* |

On Wednesday the 5th inst. a Tyfoon swept over the city of Canton. It began in the evening and continued throughout the night and the next day, blowing its best about 2 o'clock in the morning. The damage done by the Tyfoon at Canton is small, but not so at Kumsingmoon, Macao, and elsewhere on the coast.—*Canton Paper.*

The American ship *Levant*, Capt. Dumaresq, which arrived on the 7th of August, the day after the gale, came in with royals set, from Gaspar Island, in fourteen days, having had light winds all the way up the China sea, and *did not feel the tyfoon.* This important fact is stated in the Canton Register of August 11th.

Extract from a private letter from on board the ship *Lady Hayes*, which left Macao Roads a day or two before the storm, and returned to Kumsingmoon, after the gale.

"Early on the morning of the 5th, we observed indications of bad weather. At 10 a. m. the wind freshened a little from the same quarter it had been for the last twenty four hours, viz. *north;* so we thought it best to turn her head back again to look for shelter, fancying ourselves to be about thirty five miles off the land. We carried a press of sail until noon, when we found we had too great a distance to run before we could get into shelter, and expecting it would get so thick that we could not see our way; so we turned her head to sea, and clapped on as much sail as she could stagger under, *steering S. E. by E.* The wind being then at north, we were desirous of getting as far off the land as possible, expecting the wind round to the eastward, there being a most *tremendous swell* from that quarter. *At 4 p. m.* it was blowing in severe gusts, and we shipping a good deal of water, and the ship becoming unmanageable. About 8h. 30m. *the wind began to veer to the west*, but continued to blow as hard as ever, till midnight, when it *drew round to south*, and moderated a little. It continued to blow hard from that quarter until noon of the 6th, when it moderated fast, and we began bending other sails in room of those that were split. When the gale commenced, which we consider it did *at 1 p. m. on the 5th,* we were about twenty miles east of the Lema; where we were when it ended, it is hard to say, as we saw nothing till the morning of the 7th, when we made Mondego Island. We hardly think we could have had the gale so heavy as those inside; and what is most extraordinary, the wind with them *veered to the eastward round to south;* but with us it veered to the *westward* round to the south.* It was fortunate for us that it veered to the westward; for had it veered to eastward, we should most likely have been driven on shore among the islands, as we could not have been more than fifty miles off the land [?] at 8 p. m. on the 6th."—*Abridged from the Canton Register of August 18th.*

On the reduced chart which is given herewith, the tracks of the Lady Hayes and the Levant are laid down by estimate, from the printed accounts. The small dotted circle B, surrounded by the storm arrows, is supposed to indicate the position of the centre of the storm at the time the Raleigh was overset; and the position of the latter should be marked somewhat nearer this circle, according to the lat. and long. of the Raleigh on the 5th, which Col. Reid has given in her log. The course of the storm appears to have been N. 72° W., and its centre is supposed to have been opposite the Raleigh, about *8h. 20m.* a. m. on the 5th; but this cannot be ascertained with precision, as the indications of the barometer do not appear to have been closely watched and recorded during this terrific period of the storm.

Having shown the rotatory character of these tempests, I consider the depression of the barometer which attends them, as being due to the rotative action; and the point of greatest depression, as indicating the true centre or axis of the storm.

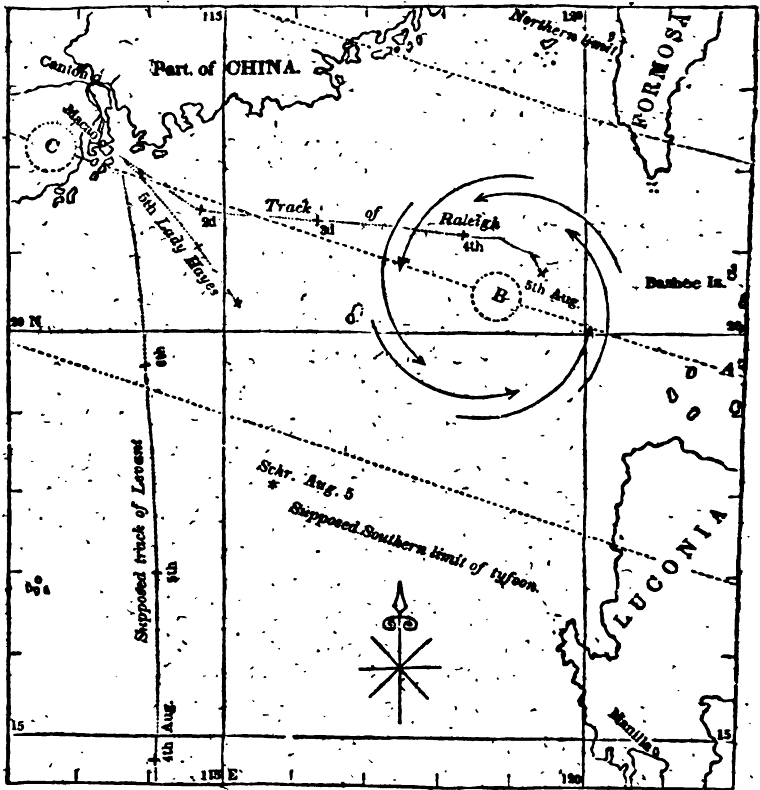
From the evidence now before us, we arrive at the following facts:

1. That the *Raleigh* met a gale which set in with the wind *at N., veering round by the E. to S. E. and South.*

2. That at the harbors and roads "inside," (Macao, Kumsingmoon, &c.) as well as at *Canton,* the gale occurred *at a later period;* and the wind also *set in at North, and veered to E. and S. E.,* in a manner similar to that reported by the Raleigh.

3. That with the ship *Lady Hayes,* off the islands near Macao, the wind also set in at North; but the ship steering S. E. by E. under a press of sail, (and doubtless falling off with the heavy sea from eastward,) the wind, towards the middle of the gale, began *to veer towards the West;* whence *it drew round to South,* towards the close of the gale.

4. That the violence of the wind was apparently *greater with the Raleigh*, than with the Lady Hayes.



5. That the gale was experienced by an English schooner, Aug. 5th, in lat. 18° 2' N. lon. 115° 50' E.; but the *Levant*, arriving on the 7th, in her course through the China sea, *did not encounter the gale*.

6. That the fall and rise of the barometer at Macao, and with the Raleigh, and the strength and changes of wind with the latter, were such as are often exhibited near the centre of a hurricane; and that the minimum depression of the barometer occurred about *seventeen hours later at Macao*, than with the *Raleigh*.

These facts seem to establish the following conclusions:

1. That the Tyfoon advanced *in a westerly direction*.

2. Negatively;—that it did *not* pass through the China sea, from N. E. to S. W., nor on the opposite of this course.

3. That it was *a progressive whirlwind storm*; turning *to the left*, around its axis of rotation.

4. That its centre of rotation passed to the *northward* of the *Lady Hayes*; and to the *southward* of the *Raleigh* and of *Canton*, and the anchorages near Macao; and nearly on the line A, B, C, as marked on our chart.

5. That the rate of its progress was about *seventeen nautical miles per hour*.

6. That the extent or diameter of the violent part of the gale, as deduced from its duration and rate of progress, was about four hundred nautical miles, or equal to six or seven degrees of latitude.

7. That the latter induction agrees with the geographical evidence which has been obtained of the visitation of the storm.

The progress of the tyfoon being taken at 17 miles per hour, it follows that the excess of velocity of the wind at E. with the Raleigh, over that of the wind at W. with the Lady Hayes, supposing the rotation to have been in a circle, would be more than thirty miles an hour; allowing nothing, however, for difference of retardation of the surface wind, and not taking into the account the additional retardation which the west wind of the Lady Hayes must have been subject to, in its recurving course over the land. If a circle be drawn on the chart around each of the points B and C, with a radius equal to 3 or 3½ degrees of latitude, these circles will comprise, somewhat nearly, the field of action of the storm, at the two periods of 9 a. m. of the 5th, and 2 a. m. on the 6th of August.

The progressive velocity and course of this tyfoon, is nearly the same as that of the Trinidad hurricane of June, 1831; and the rate of progression also corresponds nearly to that of the Antigua hurricane of August 12th, 1835. See tracks Nos. I, and V, on my chart of the courses of hurricanes, in the April No. of the Nautical Magazine, 1836.*

This examination of the case before us, appears to show that the direction of rotation, and the course of progression of this tyfoon, while crossing the China sea, agree with those of the hurricanes of the West Indies; and that *its course was not controlled, or materially influenced, by the existing southwest monsoon.*

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* For this chart, see also Silliman's Journal, Vol. XXXI, or Reid on the Law of Storms, Chart III.

### *Methods for Escaping its Violence.*

The professional readers of the Nautical Magazine will naturally inquire for the best method by which the Raleigh might have avoided the heart of the tyfoon, had its true character, and probable course, been known. To this I answer, that the Raleigh being bound to the Bashee islands, and having sea room, and the gale having set in from N. or N. N. E., which showed that the ship was then not far from the centre of its path, its greatest severity could have been avoided by either of the following methods:

*First*, by tacking to the N. W., upon the wind, and, as the latter veered eastward, hauling up for Formosa and the Bashee islands, so far and as fast as the veering of the gale in this direction might allow.

*Second*, by standing away to W. S. W. with a view of saving time as well as distance, in the escape, and keeping off more to the southward, as the wind should veer to the westward; and when the barometer began to rise, by bearing away, under the heel of the storm, for her point of destination.

The advantage of the first method would consist in having to run a shorter distance off her course, in order to avoid the centre of the gale. Its disadvantages consist in being too much headed off at the outset, and perhaps, in getting too far northward to make the best of the S. W. monsoon, after the gale should have terminated. The advantages of the second method would consist, in running off more rapidly, with a fair wind and sea; in getting under the southern semi-circuit of the gale, where, owing to the course of the wind being counter to the progress of the storm, it becomes less violent; in having almost throughout, a fair, instead of a head wind; and, finally, in being left by the storm to the windward of the point of destination, as regards the existing monsoon. The disadvantage, if any, of this method would consist in the greater extent of the rout; but as this would be accomplished under far more favorable circumstances, and probably in much less time than the northern, it can hardly be counted as an objection. It would, however, have been necessary to avoid the *Paracels*, in shaping the southern course.

The second method for avoiding the heart of this storm, therefore, would appear to have been preferable. But had the ship fallen under the more northern portion of the gale, toward the dotted line which crosses Formosa, thus taking the wind first at N. E., or E. N. E., she should have kept to the wind, with her head to the northward. But if her position had been nearer the dotted line which crosses Luconia, taking the wind first at N. W., she should first have brought the wind on her starboard quarter, and subsequently have bore away, as the wind veered by the west.

Some further notices of tyfoons may now be added, to show that the results just noticed, are not peculiar to this storm alone, and that other tyfoons of the China sea pursue a similar course, and exhibit the same rotative action.

### *Canton Tyfoon of Aug. 3d,* 1832.

At *Macao* the wind set in from the *north,* and reached its greatest height about 1 p. m.; continuing with the same violence till 5 p. m., when it *veered suddenly to the southward,* but with diminished strength. When the fury of the gale was exhausted, the quicksilver rose at the rate of three tenths per half hour. *Barometer Aug. 2d,* 8 *a. m.* 29.68;—8 *p. m.* 29.34;—*Aug. 3d,* 8 *a. m.* 29.34;—5 *p. m.* 27.88. Other land barometers differently adjusted, fell to 27.96 and 28.05.

At *Cap-shuy-moon* the gale began at N. and N. W., between which points it blew with tremendous violence; shifting, towards the conclusion, to S. E. whence it blew more moderately. The *barometer,* in the early part, *fell to* 28.20.

The American ship *Don Quixote* left on the day before the tyfoon; and returned on the 5th with loss of mainmast.

Since the tyfoon, the British brig *John Biggar,* from Manilla, has come in dismasted. The Spanish brig *Veloz,* also from Manilla, has arrived with loss of mainmast.

A letter from the commander of the Dutch ship *Fair Armenian,* which foundered about thirty miles westward of the Grand Ladrone, says:—"On the evening of the 2d inst. we made the Grand Ladrone, and on the morning of the 3d it came on a tyfoon blowing off the land; this about noon increased to a tremendous height and dismasted us; unshipped and broke our rudder, and carried away a great part of the bulwarks. The gale was at its height about 4 or 5 p. m., and after dark gradually moderated."

The *Edmonston, Caledonia, Esperança* and *Italy* have come in without damage. The *Caledonia* on the 3d, when in *lat.* 17° *N., lon.* 113° 50′ *E.* experienced a *strong gale from W. veering to S. W. and S.,* with a heavy and confused sea. *The barometer fell to* 28.50. The *Edmonston,* on the same day, when within seventy miles of the land, felt the *same weather,* which brought her under bare poles for four hours.

At *Bocca Tigris,* the weight of the tyfoon, which in *Canton and Whampao ranged from N. to N. E.,* was felt about 4 or 5 p. m.; the *barometer standing at* 29.10. About 6 p. m. the quicksilver rose and the gale began to abate.

At *Canton, Aug. 3d.* Blowing hard at N. and N. E. with violent gusts; *barometer* 29.15; and for the most part rain. *Aug. 4th.* First part blowing hard, *wind S. E. barom.* 29.70;—middle and latter part strong breezes and fine weather.—*Canton papers of August,* 1832.

*Extract from the journal of an American shipmaster bound to Canton.* "Aug. 2d, 1832, (nautical time,) *lat.* 18° 34′ *N., lon.* 114° *E.; barom.* 29.56. First part light and baffling winds *from E. to N. E. and N.* and hazy:—middle part the same:—At 4 *a. m. calm, barom.* 29.59:—At 4.30 a. m. a breeze sprung up from W. N. W.;—made all sail by the wind. Latter part and end, strong W. N. W. wind and rough head sea. Took in the royals, flying jib, and fore and mizen top gallant sails. *Barometer at noon* 29.40. The weather, however, looks very fine, and the breeze is steady at W. N. W. *lat.* 19° 54′ *N., lon.* 113° 50′*E.*

*Aug. 3d* commences with a strong steady breeze at W. N. W. and hazy weather, barometer falling fast. At 2 p. m. down to 28.98, but not the least unfavorable *appearance* in the clouds, sea, or weather. [The ship was at this time running into the path of the gale, from its southern side.] I must acknowledge that the rapid fall of the mercury, within the last ten hours, has alarmed me not a little, and we are now preparing for the worst of weather.—At 4 *p. m. barom.* 29.25 and the wind freshening; single reefed topsails. The old tars who have seen sail carried on this ship through thick and thin in the stormy regions of the southern ocean, now look at each other with amazement at such preparation for apparently nothing. Towards evening the weather begins to look unfavorable; the sun went down in a body of clouds, deeply tinged with red; not the rich and variegated tints that give rise to pleasurable sensations to all who look upon them, but the fierce, glaring, angry red that creates distress in the bosom, particularly of a mariner. After sunset the moon (at the 2d quarter) could be seen at intervals through the clouds that are driving *from the N. E.* at the rate of twenty knots, and the lightning *shooting up* from every point of the compass. *At* 8 *p. m. barom.* 29.15. Took in all sail but the close reefed fore and main topsails and fore-topmast staysail; the wind still steady at W. N. W. Sounded in 45 fathoms, the *Grand Ladrone bearing W. N. W.* 38 *miles. At* 10 *p. m. the wind suddenly shifted to W. N. W.* [N. N. W.?] *in a squall.*—Heavy rain and distant thunder until 5 a. m.:—*Had continued shifts of wind all round the compass. At* 7 *a. m.* a steady gale very severe, from about N. W. and constant rain:—hove to under the reefed main topsail:—*At* 8 *a. m. barom.* 29.!!—Latter part and end, the real, genuine, unadulterated Chinese *Tyfoong;* a steady roar and constant rain; took in the main topsail.

*Aug. 4th.* (P. M. of 3d.) The first quarter of this day extremely severe gale and thick weather.—*At* 2.30 *p. m. barom.* 28.88; shortly after which it began to rise:—*at* 6 *p. m.* 29.05;—*at* 8 *p. m.* 29.08, and moderating.—During the night, *hard gale from W. to W. S. W.* and torrents of rain.—*At* 4 *a. m. wind S. W. to S. S. W.* and hazy:—made sail and by 6 a. m. had royal and studding sails set. During the day passed a number of wrecks, and when we arrived, (5th,) found that the hurricane had been very severe and caused immense destruction."—*New York Journal of Commerce.*

## *Canton Tyfoon of Sept. 23d, 1831.*

The American ship *Galen*, from the Sandwich Islands, bound to Canton, encountered bad weather off the Bashee Islands on the 21st of September, and on the 23d near the Lema Islands, lost her mizen mast, fore and main topmasts, &c.

The British barque *Agnes*, from Singapore, also lost her foremast on the 23d, and was obliged to cut away the remaining masts. She was at anchor on the 27th, about nine miles southward of the Grand Ladrone.

H. C. ship *Hertfordshire* and Danish ship *Norden*, arrived on the 25th [from the southward] and experienced no bad weather; the latter reports that on the 24th a very violent swell was running down from the north-eastward, but the barometer indicated no change, and neither of these vessels were aware of the tempest till their arrival at Macao.

At *Canton* early in the morning of the 23d September commenced a *hard northerly gale*, which continued without intermission for twenty four hours. The tide rose to a great height and much damage was sustained; an official return to the authorities at Canton, states, that after it was past, *one thousand four hundred and five* dead bodies were picked up along the coast. The gale was far more severely felt at *Macao* and Kum-sing-moon, where it is described as having been truly dreadful.—*Canton papers.*

The narrative of Capt. Lynn, of H. C. S. Duke of Buccleugh, appended to his Star tables for 1822, contains accounts of *four* several tyfoons which were encountered by the convoy under H. M. S. *Swift*, Capt. Hayward, which left Macao Roads on the 15th of June, 1797, bound homeward by the eastern passage. The first of these storms occurred on the 19th June, in lat. 22° 9′ N., lon. 117° 3′ E. The wind set in at N., and veered to N. E. by N.; but owing, probably, to the course of the ship, veered back to N., and subsequently by N. W. and W. to S. Barometer, 29.

The second was met on the 2d July, in lat. 19° 4′ N., lon. 124° 18′ E., and ended on the 3d. The wind set in at N. E., and veered by N. and W., as on the 19th of June; the ship having been kept before the wind, probably as before. Barom. 28.77. The Swift is supposed to have foundered in this storm.

The third tyfoon was encountered on the 8th July, in lat. 16° 54′ N., lon. 126° 9′ E. Barometer, at lowest, 28.40. This gale commenced at N. N. E.; but the ship running to the southward, as before, the wind again veered to N. and N. N. W., and thence shifting, after a lull, to S. S. W.

A fourth tyfoon was encountered on the 17th July, lat. 16° 54′ N., long. 126° 9′ E., in which the wind set in at the same point as before, and veered also in the same manner. Barometer, 28.55.

These and other facts had been the basis of my inductions, in relation to the tyfoons of China and the storms of the North Pacific; and the voyages of Cook and others upon the coasts of Japan and China, and the journals of whale ships in the Northern Pacific, had afforded good evidence that the same system of storms prevailed in the North Pacific as in the North Atlantic

From a comparison of the foregoing accounts, it appears that those ships suffered most severely, which fell under the *northern* semi-circle of the storm. This result, probably, would not follow in the higher latitudes, where the storm has recurved to the northward and commenced its easterly course.

### *Hurricanes of the Asiatic Seas.*

It is generally believed that the hurricanes of the Indian seas occur only or chiefly at the change of the monsoons; but this opinion appears to be of doubtful accuracy.

From the valuable meteorological journal which appears monthly in the Canton Register, I have compiled the following statement of the periods of change in the N. E. and S. W. monsoons at that place:

| | Vernal change from N. E. to S. W. | Autumnal change, from S. W. to N. E. |
|---|---|---|
| 1830. | From 20th to 28th of April. | From 5th to 12th of October. |
| 1831. | " 7th to 17th " | " 1st to 14th " |
| 1832. | " 4th to 7th " | on 25th September. |
| 1833. | " 9th to 14th " | " 9th to 30th " |
| 1834. | " 3d of April to 8th of May. | " 19th to 30th " |
| 1835. | " 8th to 21st of April. | " 10th to 24th "* |

The American ship *Parachute,* at Boston from Calcutta, experienced a very heavy gale to the northward of 18° N. lat. in the Bay of Bengal, on the 23d, 24th, and 25th of August, 1831. Spoke the *Nandi* from Bengal to Liverpool, dismasted in the gale.—*London shipping lists.*

*Bombay, June 24th,* 1837.—One of the severest gales that has occurred here for the last forty eight years, commenced on the evening of the 14th inst. On the morning of the 15th the scene of destruction was displayed. The roaring of the wind and thunder was truly awful; large palmira trees, six feet in diameter and seventy feet in height, were torn up by the roots, and many houses completely unroofed.

The accounts of hurricanes in the Asiatic seas, given us by Col. Reid, are also more common to the regular monsoons than to the periods of change.

### *Tyfoon at Manilla and Hurricane at Balasore, Oct.* 1831.

The following account of a tyfoon in the China sea in 1831, is interesting insomuch as it affords probable grounds for connecting the hurricane at Manilla, Oct. 23–24, with that of Oct. 31, at Balasore, on the shores of the Bay of Bengal.

*Extract from the private journal of Wm. F. Griswold, Esq., Master of the ship Panama, on a voyage to Canton, October,* 1831.

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* From these and like statements of the changes of the monsoons at other points, some useful inductions might be obtained.

*October 23d, (Nautical time,) lat.* 9° 17′ *N., lon.* 117° 16′ *E.* Wind came out at southward and continued until 10 p. m., then died away and commenced from the northrward, with a heavy head sea.—Forenoon breeze from N. W. and clear weather. *Lat.* 9° 45′ *N., lon.* 117° 25′ *E.*

*Oct. 24th.*—Pleasant breezes from N. W. and hazy, steady weather. A sea rolling from the northward. I suppose there has been a gale in the China sea which has not yet reached us.—Evening wind rapidly increasing and barometer falling from 29.75 to 29.40. Midnight reefed topsails. —9. a. m. double reefed do.—*barometer* 29.20. Ends with tremendous gale from the westward and heavy sea—*barometer* 29.10. *Lat.* 11° 51′ *N. lon.* 118° 20′ *E.*

*Oct. 25th.*—Heavy gale from W. S. W.—*barometer* 29.05. Gale hauling to the southward. Evening more moderate. Made a little sail. Wind at 7. p. m. from southwestward; at 11 p. m. from southward. In the morning at 5 o'clock the wind came out at S. E. (*barometer at* 29.10) and blew a perfect hurricane. Hove to under mizen staysail;—*barometer at* 1 *p. m.* 29.05—4 *p. m.* 29.00—7 *a. m.* 29.10—8 *a. m.* 29.20. I believe this fall of the barometer to be, in this latitude, very remarkable.

This gale was on the 24th and 25th October, civil time, and from its peculiar features and double fall of the barometer, there appears something like the falling in of two hurricanes on the same track. It was, doubtless, in whole or in part, the same hurricane that visited Manilla on the night of the 23d of October, and which is noticed by Col. Reid. The irregularities of the storm *may* have been caused by its passage over the Philippine Islands, the Panama being then off the Strait of Mindora, and about 210 miles from Manilla. I have deemed it not improbable, that this storm was the same that visited the Bay of Bengal on the 31st of the same month, and was so destructive at Balasore, and on the neighboring coast. The course from the Panama's position to Balasore is about N. 73° W., and the distance, say 1920 miles, which would give a rate of progression of 11½ nautical miles per hour; which coincides with other storms which have formerly been examined. It is important to ascertain if this storm crossed the Burman Empire, immediately previous to its appearance in the Bay of Bengal.

## *Panama's Hurricane in Indian Ocean, January,* 1832.

In order to add to the stock of available facts for tracing the storms of South Latitude, I add the following account of a hurricane in the Indian Ocean, on the 25th of January, 1832.

"*January 25th, (nautical time,) Lat.* 20° 14′ *S. Lon.* 80° 36′ *E.* Strong breezes and squally, with every appearance of a gale; *barometer at noon* 29.57, *having fallen from* 29.80. *At* 1 *p. m. barom.* 29.50;—

*at* 4 *p. m.* 29.45;—*at* 8 *p. m.* 29.50;—*at midnight* 29.30: reefed, &c. and brought the ship to. During the night, heavy and increasing gale *from E. S. E. to E. At* 4 *a. m. barom.* 29.00;—*at* 6 *a. m.* 28.90;—*at* 8 *a. m.* 28.80;—*at* 10 *a. m.* 28.70;—*at noon* 28.60.—Tremendous gale and dangerous sea. *Lat.* 20° 14′ *S., Lon.* 76° 47′ *E.*

"Jan. 26. Blowing a tremendous hurricane. Lost the fore-topsail and foresail and scud under the fore-topmast stay-sail, which split, and the ship broached to, lying on her beam-ends in the trough of the sea. Night came on gloomy and dark, the hurricane increasing. *At* 10 *p. m. the wind began to abate, hauling eastward, and finally to E. N. E.:* ended with pleasant weather. *Barometer at* 1 *p. m.* 28.55;—*at* 2 *p. m.* 28.50;—*at* 4 *p. m.* 28.45, (*lowest*);—*at* 8 *p. m.* 28.50;—*at* 9 *p. m.* 28.60;—*at* 10 *p. m.* 28.70;—*at* 11 *p. m.* 28.80;—*at midnight* 28.90;—*at* 1 *a. m.* 29.00;—*at* 2 *a. m.* 29.10;—*at* 3 *a. m.* 29.20;—*at* 4 *a. m.* 29.30;—*at* 6 *a. m.* 29. 40;—*at* 8 *a. m.* 29.50;—*at* 10 *a. m.* 29.55;—*at noon* 29.60: *Lat.* 21° 46′ *S., lon.* 75° 59′ *E.*"—*Journal of Wm. Frederick Griswold, Esq., Master of Ship Panama, from Canton, bound to New York.*

As no change of wind is specified at the commencement of this storm, it would appear to have begun in the direction of the south-east trade, the latter being a fair wind for the ship, which appears to have been under the southern semi-circle of the storm; and the progress of the storm towards the southwest, nearly in the course of the ship, doubtless protracted its duration. The direction and veering of the wind in this storm, is in perfect accordance with the facts and inductions adduced by Col. Reid, relating to the Culloden's storm of March, 1809; the direction of rotation being *towards the right*, as in other storms in south latitude. This hurricane of the Panama, is one of the storms on which my own inductions for southern latitudes had been founded.

## *Natural System of Winds and Storms.*

It will be found difficult to reconcile with the received theory of winds, the facts which have claimed our attention while pursuing this inquiry. To me it appears, that the courses of the great storms may be considered to indicate with entire certainty, the great law of circulation in our atmosphere; and that the long cherished theory which is founded upon calorific rarefaction, must give place to a more natural system of winds and storms; founded, mainly, upon the more simple conditions of the great law of gravitation.

## *Storms of Europe.*

The courses and developments of the storms which pass over the island of Great Britain, are believed to be more complex than on the shores of the United States. It is not improbable, that the course of many European storms is in a southeastern direction. A comparison of marine reports has shown me, that while a storm was blowing at W., or W. S. W., in the English channel, it was blowing S. E. at Elsineur; at N. E. on the east coast of Scotland; and at N. and N. W. in the Irish channel; thus exhibiting, plainly, a rotation to the left. The great storm of Nov. 29, 1836, appeared in the north of Germany after it left the shores of England, and other British storms have also exhibited an easterly progress. But it is on careful investigations, hereafter to be made, that we must rely for a proper development of the system of European storms.

New York, October 20, 1838.

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## Art. II.—*On the Meteor of May 18th*, 1838, *and on Shooting Stars in general;* by Elias Loomis, Professor of Mathematics and Natural Philosophy in Western Reserve College, Ohio.

On the evening of May 18th, 1838, a very remarkable meteor was seen throughout most of the northern part of the United States, and a considerable district of Upper Canada. It attracted general attention from its size, brilliancy, train, length of path, and slowness of apparent motion. Observers, almost without exception, pronounced it the most remarkable meteor they ever saw. Having obtained observations at four or five different places, and learned the general phenomena of the meteor, I inserted a brief notice of it in the Cleveland papers, and concluded with requesting information from any one who observed it. Above twenty letters were received in answer to this invitation; and as considerable information has been obtained through other channels, the observations are as numerous as could be desired. Their accuracy will be considered hereafter. The result is, that the meteor was noticed throughout all the north of Ohio; at Detroit and Ann Arbor, in Michigan; at various places in the State of New York; at two stations in New Hampshire; and in various parts of Canada. The evidence that all saw the *same* meteor is as follows: 1. All saw a meteor at the same instant. Throughout Ohio, the time was that of early candle-lighting. The brightest stars were just becoming visible. In New Hampshire, the time was a little after eight o'clock. The phenomenon, as near as can be ascertained, appeared every where at the same absolute instant. 2. The meteor was every where seen in the same place. Not in the same direction as referred to the points of the compass, but occupying the same absolute position as referred to the earth's surface. That is, the appearances are perfectly explained by supposing a single meteor of great size, elevated about thirty miles above the earth's surface, to have described a nearly horizontal path of more than two hundred miles. Such a supposition will satisfy all the observations within the limits of the unavoidable errors of observation. 3. The meteor was every where of remarkable size. It was of such splendor as is very seldom seen. 4. It exhibited a train, besides several peculiarities so extraordinary, as to identify it without danger of mistake. It broke into several fragments which fell behind the main body and followed at some interval. This will be considered more fully hereafter. These four facts combined, prove conclusively that it was indeed the *same* meteor seen by the different observers. The evidence is the same in kind, and well nigh the same in degree, as that which assures us that it is one moon which is seen in the northern and southern hemispheres. Assuming, then, that all the observations were made upon a single object, I proceed to determine as accurately as possible the height and course of the meteor. At Hanover, N. H., the meteor was observed by Professor Hubbard. When first noticed, it bore S. 80° W. elevated above the horizon 9° 38′; it disappeared N. 69° W. at an elevation of 3° 24′. These numbers were obtained by measurement from the remembered position of the meteor, and were communicated to me by Professor Young. At Clinton, in New York, the meteor was observed by Professor Catlin, of Hamilton College. It first appeared S. 13° 25′ W., elevated 4° 30′; it disappeared N. 67° W., elevated 8°. At an intermediate point it bore N. 87° 30′ W., elevated 12° 36′. At Buffalo, N. Y., the meteor was observed by Mr. R. W. Haskins. He first saw it a little south of east, and it disappeared a little east of north. Its greatest altitude was 27°. At Hudson, Ohio, the meteor was observed by Professor Barrows. It was first seen N. 83° E., elevated 7°; and disappeared N. 35° E., elevated 6°. In Aurora, a town adjoining Hudson, the meteor was observed by Mr. E. Brown. He first saw it due east, elevated about 8°; and it disappeared N. 30 E., elevated 8°. At Ann Arbor, Michigan, the meteor was seen by Messrs J. and L. Chandler, to move nearly parallel with the horizon, at an elevation of three degrees, according to one, and of four degrees, according to the other. It was seen in the N. E. quarter, but the precise direction could not be given, as the estimate was made when they had no opportunity of returning to the spot of observation. The preceding observations are the most precise of any I have been able to obtain. They were all made by the aid of instruments, and the chief error therefore to be apprehended, is that arising from the difficulty of exactly remembering the apparent position of the meteor. It is believed, however, that in the above observations, this error is small. In this first comparison, I neglect entirely such observations as give mere *estimates* of elevation by the eye; for it is a remarkable fact, that almost every one over-estimates angular elevation near the horizon. I have made the computation from the above data, and find the perpendicular elevation of beginning 28.5 miles. The place where it then stood in the zenith was in Lycoming county, Penn., Lat. 41° 16′, Long. 1° west from Washington. At its explosion, its height was 32.1 miles, and the place where it then stood in the zenith was in Upper Canada, Lat. 44° 7′, Long. 2° west. At an intermediate point, its height was 34.8 miles, and it was then vertical over Monroe county, N. Y., Lat. 43° 0′, Long. 0° 46′ west. The length of path then was 218 miles, and its mean course N. 13½° W., passing vertically over Rochester in the State of New York. In this computation I have aimed to make the positive equal to the negative errors, and the sum of the errors, disregarding their signs, a minimum. The beginning, as I have here assigned it, rests upon the observations at Clinton, Hudson, and Aurora. It appears not to have been seen so early in its course either at Hanover, Buffalo, or Ann Arbor. The middle point of its path, near Rochester, appears to have been observed at all the stations. The observations at Hudson and Aurora having been made near each other, I consider as one observation, and take their mean. It is impossible perfectly to satisfy the observations. The result I have above given, makes the errors of the observations as follows: Hanover + 3° 45′; Clinton − 2° 54′; Buffalo − 2′; Hudson − 5′; Ann Arbor − 44′. The positive are equal to the negative errors, and I am unable to assign the meteor a position which shall diminish the sum of the errors. The errors at Buffalo, Hudson, and Ann Arbor, are quite within the limits of the unavoidable errors of such observations. Those at Hanover and Clinton seem somewhat large, yet when it is remembered, that these measurements were not taken till more than a month after the meteor appeared, I think we must admit the possibility of errors of this magnitude. The assigned termination of the meteor's flight, rests upon the observations of Hanover, Clinton, Hudson, and Ann Arbor. The errors of the observations appear to be, Hanover+27′; Clinton+2′; Hudson+54′; Ann Arbor−1° 24′; all of which are quite admissible.

The observations at Clinton make the meteor's first appearance S. 13° 25′ W. I think it probable there is some mistake here, or if not, we must suppose the meteor to have been seen at Clinton much earlier than at any other station. At all events, it is impossible with this single observation to trace the meteor with confidence farther south than I have done.

It will be observed, that the three points in the meteor's path which I have above given, do not lie in a straight line. The middle point is more distant from the surface of the earth than either of the extremes by 2.7 miles, and allowing for the convexity of the earth, the total curvature in a vertical plane is about six miles. But the projection of the meteor's path upon a horizontal plane, deviates still more from a straight line. The curvature here amounts to forty one miles, the convexity being turned towards the east. We may suppose a part of this irregularity to arise from the errors of the observations, yet I think it well nigh certain, that the path was actually crooked.

Having thus deduced the meteor's path from the best observations, I proceed to inquire how these results accord with the remaining observations. A meteor was seen at Raymond, in the eastern part of New Hampshire, a little past 8 o'clock, on the evening of the 18th. It bore nearly west, at an elevation of from 5 to 10°, moved north westerly, descending rapidly towards the horizon. This description accords as nearly as could be expected with the position I have assigned the meteor. At Mount Upton, Chenango county, N. Y., "soon after sunset, on the evening of the 18th, a very brilliant meteor started from that part of the heavens which declines a little to the west or southwest from the point over head, and pursued its course about due N. W., disappearing behind the hills in that direction." According to my results, the meteor could not have been elevated much above fifteen degrees at this place, and if this observation were to be implicitly relied upon, we must infer that the meteor was higher than I have supposed, or that its path was farther to the east than I have assigned it. The language of the observation, however, is very vague, and I think it highly probable, that the observer never saw the meteor so high as his language would naturally imply, but inferred from its final direction that it must have originated in that quarter. At Carroll, Chautauque county, N. Y., a meteor was seen about dusk on the evening of the 18th. It appeared first in the east, elevated 25 or 30 degrees above the horizon, and disappeared in the north perhaps about 5° above the horizon. All this accords sufficiently well with my results. In one of the Canadian papers, the meteor is noticed as having been seen in various places, but the observations are too vague to be of the least value. I have received a vast number of observations from the counties of Ashtabula, Trumbull, Geauga, Portage, Cuyahoga, and Huron, all in the northeastern part of Ohio. The observations agree about as well as could be expected, if they had all been made from precisely the same station, with the exception that the most eastern observations assign the meteor somewhat the greatest altitude. The altitudes are almost without exception given too great, and commonly twice too great. The great variety of observations made in the vicinity of Hudson, although somewhat loose, must satisfy any one that the meteor was very distant and at a considerable elevation. No one can believe that a hundred different meteors, all of them of the most extraordinary kind, and characterized by the very same peculiarities, should appear at the same absolute instant, within a limited district, and all moving in such directions, and exhibiting such appearances as would be presented by one large, remote, and elevated meteor, while only a single meteor appeared to any one of the numerous observers. The case seems too plain for further argument.

I have now, as appears to me, assigned such a position to the meteor as reconciles all the observations within the limits of unavoidable error. This determination is liable to some uncertainty; yet I believe the uncertainty is not so great as materially to affect any theoretical conclusions to be deduced.

Let us now inquire for the velocity of the meteor, as referred to the earth's surface. The length of path seen at Hanover was 201 miles. The time of observation was estimated at eleven seconds. This estimate is probably too great, yet it gives the velocity of the meteor 18 miles per second. At Clinton, the path observed was at least 218 miles, and the time was estimated at five seconds, making a velocity of 43 miles per second. The path observed at Buffalo was probably 112 miles, and the time was estimated from 4 to 5 seconds, which gives a velocity of 25 miles per second. At Hudson and Aurora, the path seen was about 218 miles, and the time estimated from 6 to 7 seconds, giving a velocity of 33 miles per second. These are the observations I think most to be relied upon; and the average velocity resulting from them, is 30 miles per second.

Let us now form some estimate of the magnitude of the meteor. Its diameter at Hanover was estimated at one fourth that of the moon, and its least distance was 281 miles. Its absolute diameter then was .65 mile. At Clinton, the meteor appeared very much elongated in the horizontal direction, and was followed by two smaller portions at intervals of less than a degree each. The breadth of the head was estimated at eight minutes, and its distance was 118 miles, which makes the absolute breadth .27 mile. The length of the principal portion was about one degree, that is, nearly two miles. The two smaller portions which followed in the rear, were about a tenth of a mile in diameter. At Buffalo, also, the meteor appeared elongated, its horizontal diameter being four or five times the vertical. Its least diameter was estimated at half that of the moon, and its distance being about 66 miles, its absolute breadth must have been .29 mile. Its length was four or five times this amount. At Hudson, its diameter was estimated at one third that of the moon, and being distant 226 miles, its absolute diameter was .66 mile. The observations made in other places agree substantially with the above, and from them we may infer, that the absolute diameter of the meteor was about three quarters of a mile. At the more distant stations, the meteor appeared nearly circular, but from the nearest points of observation, it appeared decidedly elongated. Almost all the observers noticed a falling off of various portions from the main body, which, lagging behind, formed a species of train. Several of these smaller portions formed a considerable fraction, perhaps one tenth part, of the main body itself.

This meteor must have consisted of matter exceedingly rare, and of very feeble cohesion. During nearly its entire route, new portions of matter were continually detaching themselves from the main body, and this finally divided into a large number of fragments. We have, perhaps, no means of forming any precise estimate of its density, yet it is doubtful whether it exceeded that of atmospheric air. The light was, without doubt, produced by combustion. The meteor, by rapid motion through the upper regions of the air, generated heat sufficient to set itself on fire, and it was probably entirely consumed in the space of ten seconds. Nothing is learned to have fallen to the earth from the meteor, as would probably have been the case if its density had not been exceedingly feeble. Moreover, the appearances were those of a body entirely consumed by combustion. But a body, three quarters of a mile in diameter, entirely consumed in ten seconds, must be supposed exceedingly combustible and of very feeble density.

One of the points respecting which I solicited information, in my communication through the Cleveland papers, was, whether any noise attended the meteor. To this question most observers replied decidedly in the negative. Two persons only represent that they heard a noise. One observer in Ohio, states that his attention was attracted by the light, and a whizzing noise resembling the burning of a slow match of powder; and an observer in the State of New York, states the same fact. Now it would be altogether superfluous to give reasons for doubting the fact as thus stated, yet it is demonstrable that if such a noise was heard, it did not proceed from the meteor. At its nearest approach, the meteor was one hundred and sixty two miles distant from the first observer, and seventy six miles from the second. At the latter place, then, supposing, for simplicity, sound to travel at the same rate in rarefied as in dense air, the sound, if any, should have been heard about six minutes after the disappearance of the meteor, and at the former place more than twelve minutes. There was little opportunity therefore for one's attention to be attracted to the meteor by a whizzing noise proceeding from it. The noise alledged existed doubtless solely in the imagination. I by no means pronounce it impossible that sound may have come from the meteor; but if a report did follow, it would come after so long an interval, that few would think of attributing it to the meteor.

Let us now compare the direction of the meteor's path with that of the earth in its orbit. The point in space towards which the earth is moving is of course in the ecliptic, and nearly 90° west of the sun. At the time in question, it was about eight o'clock in the evening where the meteor was vertical. The point then towards which the earth's motion was directed, had passed by nearly two hours the inferior meridian. The line of direction was inclined to the horizon about 52°, and its azimuth was somewhat east of north. The meteor's course was nearly north and parallel with the horizon. Its velocity was thirty miles per second; that of the earth 19 miles. The directions of the earth and meteor were inclined to each other about 64°, and the meteor's velocity of thirty miles was its velocity relatively to the earth. It is then simply a mathematical question to determine what must have been the absolute direction and velocity of the meteor's motion, in order that, combined with the earth's motion, it may give the above resultant. The velocity I find to be about forty miles per second. A part of this velocity, less however than seven miles, was due to the earth's attraction. We must then admit that a small collection of exceedingly rare matter, revolving about the sun in an orbit which at one point coincided nearly with that of the earth, but moving with about double the velocity, plunged into the earth's atmosphere, took fire, and exhibited the splendid phenomenon of May 18. That no portion of this body escaped from the earth's atmosphere and continued its solitary route, we cannot positively affirm; although the appearances seem to favor the supposition that the body was quite consumed in our atmosphere.

For the curvature of the meteor's path we can perhaps give only a hypothetical explanation. When a ball is moving with great velocity through the air, if one side be of such a form as to experience greater resistance than the opposite, it will be relatively retarded, and the path of the body will deviate towards that side. Now as it is highly improbable that the opposite sides of the meteor should be perfectly symmetrical, it might be expected to deviate more or less from a straight line. Moreover, the progress of the meteor was marked by combustion, which may be supposed to have been attended by a copious evolution of gas. Now if this gas should be evolved upon one side of the meteor more abundantly than on the other, it would become a moving force, which by reaction would cause the meteor to deviate to the opposite side. As these two causes appear to me highly probable, and adequate to account for the phenomenon, I think it superfluous to search for others. The earth's attraction would hardly produce the hundredth part of the deviation from a straight line observed in a vertical plane, and no part of that observed in a horizontal plane.

The meteor whose phenomena I have thus attempted to analyze, although certainly very remarkable, was not unlike some others on record. In the London Philosophical Transactions for 1759, is an account of a meteor which appeared in Great Britain, Nov. 26, 1758. It moved in a direction N. W. by N., describing a path of about 400 miles. It shot obliquely downwards, being from 90 to 100 miles high at its origin, and from 26 to 32 at its termination. Its velocity was computed at 30 *miles per second.* Its diameter was estimated at certainly not less than half a mile, and probably greater. Its path deviated sensibly from a straight line, and a report, like a clap of thunder, was heard from it several minutes after the meteor disappeared. In the Philosophical Transactions for 1784, are several notices of a meteor seen in England, August 18, 1783. Its direction was nearly S. S. E. Its path was computed to have been at least 1000 miles in length, sensibly crooked, though nearly parallel with the surface of the earth, and elevated more than 50 miles. Its diameter was about half a mile, and velocity *not less than twenty miles per second.* A number of minutes after the meteor's disappearance, there was heard a rumbling noise like that of distant thunder. Both of these meteors broke into several fragments, which falling behind, formed a peculiar train. They appear to have been quite similar to the meteor of May 18th, and as the fact of a rumbling noise succeeding their appearance seems to be well attested in both cases, it is a little remarkable that nothing of the kind was noticed in the late meteor. It is doubtful, however, whether any observer watched long enough to be able to decide that no such report succeeded.

It may be useful to give here a summary of our knowledge respecting common shooting stars, that we may decide whether all these meteors are to be ranked in the same class. In the year 1798, Benzenberg and Brandes undertook in concert a series of observations on shooting stars near Göttingen, in Germany. They first took stations five and a half English miles from each other, at which they observed simultaneously several nights. After three nights' watching, finding their stations too near each other, they removed one of them to the distance of nine and a third English miles. On comparing their observations, they found twenty-two which had probably been seen at both stations, and of which they were able to compute the height for at least a part of the course. The sum of the heights of 17 meteors at their disappearance was 973 English miles. The sum of the heights of 4 meteors at their origin was 199 miles; sum of the lengths of their paths, 162 miles. In 1823, Brandes, being then Professor at Breslau, resumed his observations in concert with a number of others, about twenty in all. A summary of their observations is given in Vol. xxviii of this Journal. The sum of the heights of 54 meteors at their disappearance was, according to these observations, 2761 miles. Sum of the heights of 45 meteors at origin, 2998 miles. Sum of 37 paths was 1619 miles.

In December, 1834, Mr. A. C. Twining and myself undertook a similar series of observations. We were not so successful as we expected to be; yet among the meteors observed, there were four whose paths we were able to compute. The sum of their heights at origin was 296 miles; at termination, 216 miles, and the sum of their paths, 142 miles. Finally, in Vol. xxvi of this Journal, Mr. Twining has given for one meteor the height of origin 73 miles, of termination 29.5 miles, length of path 55 miles. We have then, as the result of all these observations, the sum of the heights of 76 meteors at termination, 3975 miles, being an average height of 52 English miles. The sum of the heights of 54 meteors at origin is 3566 miles, giving an average of 66 miles. The sum of the paths of 46 meteors is 1977 miles, being an average of 43 miles. The average velocity of 13 meteors whose duration was estimated with some care, is 22 miles per second, and the velocities range from 11 miles to 36 miles per second. The size of shooting stars is very various, yet it appears that not unfrequently they have a diameter of a hundred feet.

From the preceding statements I think it will appear that the meteor of May 18th did not differ essentially from the ordinary shooting stars, with the exception of its magnitude. It appeared at about the same height, moved with a velocity no greater than is known sometimes to belong to common shooting stars, and exhibited the usual phenomena of combustion. I see then no reason for separating this meteor from the class of ordinary shooting stars, any more than a large hail-stone should be considered a phenomenon of a different kind from a small one. Shooting stars are well known to be celestial bodies, that is, to have an origin foreign from the earth; and it is no more strange that they should sometimes have a diameter of one mile, than that they should appear with a diameter of a hundred feet, or even of a single foot.

## Art. III.—*Account of a Storm in New Hampshire, in a letter addressed to Prof. O. P. Hubbard, of Dartmouth College, and dated, Newport, Aug. 20th,* 1838; by Rev. John Woods.

*Dear Sir,*—In yours of the 6th inst., you request me to forward you an account of a powerful tornado which occurred in Warner, some years since. The record which I made of it at the time, is not in a condition to be sent abroad; but by the aid of it, the newspaper accounts of the day, which I have preserved, and my own recollection, I can furnish a pretty correct narrative, which it will not be necessary you should return.

The event occurred about half past five o'clock, Saturday evening, September 9th, 1821. The wind, I suppose, was a proper whirlwind, precisely such as occasion water-spouts at sea. A very intelligent woman in Warner, who, at the distance of two or three miles, observed its progress, compared its appearanee to a tin trumpet, the small end downward, also to a great elephant's trunk let down out of heaven, and moving majestically along. She remarked, that its appearance and motion gave her a strong impression of life. When it had reached the easterly part of the town, she said the lower end appeared to be taken up from the earth, and to bend around in a serpentine form, until it passed behind a black cloud and disappeared. Its course was southeasterly. It was attended with but little rain in some parts of its course, more in others. The rain, or what appeared like it, was in my opinion taken from bodies of water which it passed over. It was said, that it lowered the water in a small pond in Warner, about three feet. To people near Sunapee lake, in New London, I was told, it appeared as if the lake was rushing up towards heaven. The appearance of the cloud to beholders at a little distance, was awfully terrific. It commenced its desolating progress east of Grantham mountain, in Croydon. In Wardell, beside other buildings, it demolished a dwelling house, and carried a child who was asleep upon a bed, into Sunapee lake.* In New London and Sutton it did considerable damage, but met with few dwelling houses and destroyed no lives. From Sutton it passed over the southwest branch or spur of Kearsarge mountain, with a gore of land belonging to Warner, called Kearsarge gore. At the foot of this mountain, it entirely demolished five barns, unroofed another, and utterly destroyed two dwelling houses and so rent another as to render it irrepairable.

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* Mrs. Sarah J. Hale, editor of the Lady's Book, a native of this town, (Newport,) and then a resident here, I believe, has published a little poem on this fact, which I think you may be able to find among some of her writings.

The houses wholly destroyed belonged to two brothers, Robert and Daniel Savary. They contained fourteen persons. In the house of the latter were three aged parents, seventy years old, I should think, or upwards. The old gentleman, as he saw the cloud coming, went into a chamber to close a window, and was there when the wind struck the house. He was carried four or five rods, dashed upon the rock, and instantly killed. A part of his brain was left upon the rock where he fell. His wife was very badly wounded, and it was thought would not recover. A child of Daniel Savary, in the same house, was also killed. In the house of Robert Savary, several were much wounded and bruised, but no lives lost. The houses and barns and other buildings at this place were not only levelled with the foundation, but the materials and contents were dashed in ten thousand pieces, and scattered in every direction. Carts, wagons, sleighs, ploughs, and sleds which were new and strong, (one ox-sled, I recollect, was entirely new,) were carried to a considerable distance—from twenty to sixty rods—and so broken and shattered as to be fit only for fuel. Stone walls were levelled, and rocks weighing two, three, or four hundred pounds, were turned out of their beds, apparently by the bare force of the wind. Large logs, also, two feet or more in diameter, which were bedded into the ground, and were fifty or sixty feet long, were not sufficiently weighty to retain their location. In one instance I recollect to have seen one large log lying upon another in such a condition, that it was thought by good judges, that ten yoke of oxen could not have moved the lower one from its bed; but both were removed by the wind several feet. An elm tree near where old Mr. Savary fell, which was one foot at least in diameter, and too strongly rooted to yield, was twisted like a withe to the ground, and lay prostrate across the path like a wilted weed. Not an apple or forest tree was left standing. One barn was seen to be taken up whole, with its contents of hay, grain, &c. After being carried several rods, it came to pieces, and flew like feathers in every direction.

From the neighborhood of the Savarys, it passed over another spur of the mountain, and fell with great violence on the buildings of Peter Flanders and Joseph True. Their houses, which were but a few rods distant, one in Warner, the other in Salisbury, were utterly demolished. In Mr. F.'s house were nine persons, two of whom were instantly killed. Mr. F. and wife were very badly wounded, but at length recovered. In Mr. T.'s house were seven, all of whom were most wonderfully preserved, except that two children, ten or twelve years old, were badly burnt by hot bricks, the oven having been heated and the bread then in it; one of whom lingered several weeks in extreme suffering and then died. The father and mother of Mrs. T., who lived about half a mile distant, were visiting there. They had just left the tea table. Mr. T. and his father-in-law went out at the door and saw the cloud, but thought at first they were so under the hill it would pass harmless over them. But they were soon convinced that its track was marked with desolation. Mr. T. just gave an alarm to his family, then ran under the end of his shop which happened to stand beyond the violence of the wind so as not to be demolished. His father-in-law, (Jones,) stood his ground until the wind struck the barn, a few rods to the northwest of him, and he saw the fragments of it flying thick in the air over his head. He then threw himself flat upon the ground by a heavy pile of wood. Instantly a rafter fell endwise close by him, entering the ground a foot or two in depth, and immediately a beam grazed down upon the rafter and lay at its feet. He and Mrs. T. were entirely unharmed. In a moment they saw, instead of a new and strong and very comfortable dwelling house, a perfect desolation. Not even a sill remained upon its foundation. Even the cellar stairs, and the hearths, which were of tile or brick eight inches square, were taken up and removed. The bricks of the chimney lay scattered along, partly covering Mrs. T., and covering to a considerable depth two of the children. Mrs. T. was soon taken up with but little injury. The shrieks and cries of the two children, under a weight of hot bricks, next pierced the heart of their father. In removing them, he burnt his hands to the bone. They were at length taken out alive, but in a state of great suffering, one of whom, as I have mentioned, after a few weeks, died. All were now found but the babe, about one year old. Supposing it to be under the bricks, Mr.

T. renewed his labor; but soon it was heard to cry in the direction of the wind. Such as could run, ran in search of it, and soon found it lying safe upon the ground beneath a sleigh bottom, ten or fifteen rods from where the house had stood. The newspaper says one hundred rods, but this is incorrect. When the wind came, the sleigh was in the barn, six or eight rods north or northwesterly from the house. The two last mentioned houses were one story, well built, and well furnished dwellings. Their materials were not merely separated, but broken, splintered, reduced to kindling wood, and scattered like the chaff of the summer thrashing floors. It was the same with furniture, beds, bedding, bureaus, chairs, tables, and the like. A loom was, to appearance, carried whole about forty rods, and then dashed in pieces. The width of the desolation here was about twenty or twenty five rods. On the higher grounds over which it passed it was forty, fifty, or sixty rods. The deeper the valley, the narrower and *more violent* was the current. From the last mentioned neighborhood it passed on to the east part of Warner, but met with no other dwelling houses, and did but little damage, except to fences and forests. The appearance of the ground where it passed, was as if a mighty torrent had swept over it, up hill as well as down. Near the boundary, between Warner and Boscawen, the desolation ceased. It was taken up from the earth, but spruce floor boards, which were taken from New London, were borne upon its bosom and dropped in the Shaker village in Canterbury, a distance of about thirty miles. In following its track in Kearsarge gore, I came to a considerable stream of water, across which had been a bridge, covered with large oak logs, split in the middle, instead of planks. These half logs were scattered in every direction, some carried, I should think, ten rods in the direction from which the wind came,—others sixty rods in the direction it went, and others were dropped near the margin at the right and left. You will see by this, they were carried along by the whirl of the wind until they reached the circumference, and then fell to the ground.

Hundreds of people came from a distance of ten or twenty miles to view the scene of desolation. There were men of sound judgment from Concord, who gave it as their opinion, that it would have thrown down the massy walls of the State prison.

One remarkable fact is, that the same day, and about the same time in the day, two other similar whirlwinds were experienced, which moved in nearly parallel lines, one passing through Warwick, Massachusetts, and the other about the same distance to the northeast. They were both less violent; but one of them at least, the one through Warwick, did considerable damage. The particulars of the other I never had.

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## ART. IV.—*Notes on American Geology;* by T. A. CONRAD.

### *Observations on characteristic Fossils, and upon a fall of Temperature in different geological epochs.*

IT has sometimes been objected, that the value of organic remains, as a basis on which to build the superstructure of geological science, is lessened by the fact that certain species range throughout different formations; but these are far from being so numerous as is generally supposed. An instance never occurs in this country, where the species of one formation are continued into an upper one in such numbers as to cause the least perplexity or dispute regarding its geological age. All the various eras are admirably recorded, each by its peculiar group of animal or vegetable remains; and to him who has carefully studied them, they are quite as intelligible as if the hand of nature had arranged them in a cabinet for his use. The few species of a lower, discovered among those of an upper group, are not always to be regarded as contemporary with the latter, as some of them are clearly accidental. Every sedimentary stratum must have been derived from a rock previously formed, and of the first sedimentary rocks, originating in the destruction of primary masses, we, of course, take it for granted that such forms of animal and vegetable life originated in the ocean in which those sedimentary strata were deposited. But when these, disintegrated in their turn, have been, at a more recent period, swept by currents into other seas, we may expect to find occasionally, some few of the species which originally existed, carried with the debris, and thus mingled with a group very different from that with which they originated. It is true, that in the present state of our knowledge of palæontology, we cannot say with absolute certainty, in every instance, which species originated with any given stratum above the first sedimentary rock; but generally, shells, corals and plants, which have been continued from one epoch to another, were diminished greatly in numbers, as if the diminished temperature had been unsuited to their organization. I do not conceive it necessary, as M. Agassiz supposes, to infer that in every grand geological epoch, the fall of temperature was so great as to destroy *every* species existing at the time, but that some were, like the human frame, more capable of resisting the influence of cold than others. Among living testacea we find some species of a particular genus confined to the tropical seas, whilst others range from the tropics to the 42° of north latitude. The *Lucina divaricata* is a remarkable instance of this ability to endure great changes of temperature: originating, as it did, in the Eocene period, it lived in both those of the older and newer Pliocene, and now exists on the coasts of Europe and America, and inhabits the seas of the West Indies, and has been found as far north as Rhode Island.

We consider those fossils which most abound, when neither broken nor water-worn, to characterize the formation in which they occur, and such as are very rare, to be non-characteristic, or accidental, as they may have been introduced with the debris of rocks of an earlier date. Thus we find fragments of *Isotelus gigas* and *Calymene Blumenbachii* in the limestone shale at Rochester, N. Y., which rock has evidently been derived from the shales of the Trenton limestone formation, and thus fragments of the trilobites of the latter period were swept into the sea, where the shales at Rochester were in process of deposition; and it is worthy of notice, that the current must have been very gentle, judging not only from the fine materials of the shale, but because it has carried only the lightest animal remains, as the thin crusts of trilobites, and rarely any of the small shells which abound in the Trenton shales. Another formation illustrates this fact in a still more satisfactory manner. At Upper Marlborough and Piscataway, in Maryland, a deposit of the Eocene period occurs, composed of the detritus of green sand, a material originating in the cretaceous epoch. One fossil of the latter formation, (*Gryphæa vomer*,*) is not uncommon among the Eocene fossils.

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* **Ostrea lateralis, Wilson.**

This is at the same time the lightest and most indestructible of the cretaceous shells, and therefore the one most likely to be carried unbroken with the detritus of the green sand.

It is very evident that a change of the mean temperature of the crust of the globe has exerted a marked agency in the destruction of one group of animal life and the creation of another; and it may be owing to this cause, that the higher the organization, the more limited in the geological series are the fossil remains. Thus the *polyparia* have a higher range than the testacea, and the latter than the trilobites, whilst the Eurypterus is still more limited. The polyp, *Cyathophyllum ceratites* dates its existence with the lower portion of the Trenton series, or lower transition, and extends throughout all the calcareous formations above, even into the mountain or carboniferous limestone; but the Eurypterus is limited to a very insignificant portion of a single formation.

The fall of temperature has not, as some geologists supposed, taken place gradually since the creation of the globe; but every phenomenon in palæontology goes to prove the existence of a certain mean temperature during a long period, and a sudden diminution of heat at particular epochs.* The change of groups of marine animals was not produced or accompanied by any convulsion, powerful enough to cause a violent rush of the oceanic waters, as the fossils of one period rest upon and even intermingle with those of an earlier date, as if both had lived and died on or near the spots where they are now found. The theory of periodical refrigeration alone can explain the sudden extinction of whole races of animals and vegetables. On the supposition that such change had resulted from uplifts, which to be reconciled with the facts, would necessarily have been sudden, a violent movement of the waters would have torn up the surface after such uplift, which has not been the case; besides, the uplifts would have been each extensive as the globe itself; an hypothesis at variance with all the phenomena which palæontology and the relative position of strata present to our daily observation. Uplifts in great numbers have taken place, and many of them were no doubt gradual, as must necessarily have been the case where they resulted from crystallization of the earth's crust: others have been sudden, produced by volcanic agency, giving rise to debacles, of which we find ample record in breccias, conglomerates, and coarse sandstones. But these formations record only the oscillations of the crust at particular periods, not marking the limits of any grand geological era, in which we recognize the fossilized remains of a peculiar group of marine plants and animals; and it is only by the study of such groups, that we are enabled to form a system of classification in strata, applicable to every region of the globe. The student of geology who has mastered all the rocks and fossils of England and Wales, limited as the sphere of observation may seem, will seldom be at a loss to recognize a fossiliferous formation as an old acquaintance, whether he may travel in China or Peru.

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* Agassiz, Edinburgh New Philosophical Journal, April, 1838.

The fall of temperature (so happily illustrated by the genius of Agassiz) which occurred at the commencement of the "Diluvial epoch" is so well supported by all the known facts, that we feel no hesitation in applying the theory to all the inferior grand formations; indeed it gives us a clew to their obscure history, without which we should study them, hopeless of penetrating their mysteries, and believing their origin inaccessible to human investigation. The phenomena of the "diluvial epoch" have long attracted peculiar attention, from the many curious and highly interesting facts which they embrace, and the great difficulty of reconciling them with existing hypotheses. Enormous angular masses, transported perhaps a hundred miles from the parent rock, and reposing on sand or gravel which even a mill stream would have swept away, bid defiance to the mighty currents which so long flourished in the imaginations of certain geologists. Whence came these floods, and whither did they go? Such gigantic movements would soon have restored the equilibrium of the waters; and truly they should have been busy during their short reign on earth, to grind down mountains into sand, roll into smoothness myriads of siliceous pebbles, plough deep trenches in the solid rocks, and polish their surfaces with sand.

The boulders rest usually on sand, gravel, or the natural soil, which would necessarily have been swept away, had currents transported these huge fragments, leaving them in every instance reposing on indurated strata. The hypothesis of ice-floes bringing them from the north, floating on the waters of an ocean, and depositing them where they are now found, has been supported by some of the geologists of the present day; but this was in direct opposition to another theory of these same geologists, that a higher mean temperature prevailed over the northern regions at that period, than now reigns in temperate climes. This would not have been the case, all other things being equal, if the northern half of the continent had been nearly all formed by the ocean, notwithstanding the mean temperature is greatly modified in the same parallel of latitude, by the presence or absence of large bodies of water, rising with the former and falling with the latter physical condition of the globe. Whence then this immense body of ice, which has scattered boulders over so vast a tract of country, appearing too at an epoch subsequent to the extinction of the *mastodon* and other mammalia, which evidently lived in this region and enjoyed an equatorial climate anterior to the icy period? Nothing can reconcile this apparent contradiction, but the admission of a fall of temperature far below that which prevails in our day, freezing the enormous lakes of that period, and converting them into immense glaciers, which probably continued undiminished during a long series of years. At the same time, elevations and depressions of the earth's surface were in progress, giving various degrees of inclination to the frozen surfaces of the lakes, down which boulders, sand and gravel would be impelled to great distances from the points of their origin. This in some cases might result from gravity alone; but in others, during the close of the epoch, when the temperature had risen, and avalanches began to descend from the mountain tops, and from numerous less elevated places, there occurred, on a vast scale, the same phenomena which now are familiar to the traveller among the Alps. Land slides, like that of one of the hills bordering the Saco river in New Hampshire, and avalanches of mud, filled with detritus of all sizes, some angular, as torn from the surface of the rocks, others having been rolled in the beds of torrents, would be propelled for many miles over the frozen lakes; and when the ice disappeared, sand, gravel, pebbles and boulders would lie promiscuously together. That a considerable elevation of land has occurred in some regions subsequent to one of the newest tertiary depositions, is certain, from the occurrence of shells of recent species two hundred feet above the level of the sea.

M. Agassiz attributes the polished surfaces of the rocks in Switzerland to the agency of ice, and the "diluvial scratches," as they have been termed, to sand and pebbles which moving bodies of ice carried in their resistless course. In the same manner I would account for the polished surface of the rocks in Western New York. Running water, carrying sand, gravel, pebbles and boulders, to which cause this smooth appearance has been generally attributed, would not be likely to polish the surfaces of rocks; and moreover, where are those circular cavities, hollowed out by whirlpools, the invariable record of bodies of water moving with the velocity attributed to diluvial floods? I doubt whether any can be found on the polished surfaces of the rocks of the Alpine regions, or on the vast horizontal floors of Western New York. I never observed them in any place where evidence of ancient water-falls or rapids was not perfectly conclusive; and they are confined to valleys and the banks of existing streams. The scratches and grooves, Mr. Hall informs us, on the rocks bordering the Genesee river, have a direction N. N. E. and S. S. W., and they therefore probably follow the dip of the stratum, down which the ice moved. Nothing is more certain, than that the surface of the earth has risen unequally, or that two distant points have been uplifted at the same period, one rising to a greater height than the other, while the intermediate space was either stationary or depressed. If a glacier had previously occupied this area, the uplifts would have produced a synclinal line in the ice, and pebbles and boulders thus brought from opposite directions. Mr. Hall has noticed this phenomenon, but attributes it to the agency of opposing currents. He observes, "the presence, in the same locality, of boulders from the north with those from the south, proves that opposite forces have prevailed either at the same or at different periods."*

While granite boulders have been removed to surprising distances from the rocks in situ, those of transition limestone and sandstone seem never to have been far removed from the parent mass, a fact which harmonizes with the theory of refrigeration. The vast thickness of granite, and its corresponding uplift from the force of crystallization, has protruded its naked summits through the overlying strata, and from these peaks, rising to a great altitude, replete with parallel fissures, and split and rent by the upheaving power, large masses would necessarily fall, and when coming in contact with the surface of a glacier, however slightly inclined from the horizon, many of the boulders might of course traverse the extreme limit of the slope, and without losing their angular form; but the limestone fragments being imbedded in the bottom of the glacier would be only affected in position by contraction and expansion of the ice, and the more extensive movements caused by its breaking up in melting, which would have ample power to wear down the angles of these fragmentary rocks.

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* Geological Reports, 1838, p. 308.

Occasionally I have seen the upper portions of limestones and sandstones broken up, a distance of several feet from the surface, but the fragments remain *in situ*. Now who can imagine such an appearance to result from a current of water? Floods, however violent, do not tear up the solid rocks in this manner, and if they did, how could these fragments have withstood their force and remained unmoved from their original position? Indeed, I think it impossible to account for this breaking up of the rocks to a distance of many feet below the surface, except by the agency of intense cold, freezing the water which filled the fissures, and thus forcing the rocks into tabular fragments, and disturbing their position by the lateral and upward pressure.

### *Remarks on the Transition or Silurian System.*

The rocks constituting the Transition or Silurian system, have been much neglected by geologists, and yet in consequence of their embracing the remains of the first created beings, and affording us an insight into the earliest physical condition of the globe, they have peculiar attractions both for the reason and imagination: indeed, the facts are colored to the eye of inexperience with all the exaggeration of romance. If we only content ourselves patiently to investigate the organic remains, the more they are carefully studied do they gain in interest, and prove to be as readily classified as any of the later formations, notwithstanding their inclined position and disturbed stratification. Without such knowledge, every step will be embarrassed, and years of labor may be unprofitably devoted to the subject. An instance of error on the large scale may be observed in the second annual report of the geological exploration of Pennsylvania, where the graywacke of the Hudson river is confounded with a rock, somewhat similar, it is true, in mineral character, which abounds in

Oswego county and forms the banks of Salmon river. Not a single species of shells or plants is common to both. The former is highly inclined, and on its edges rests unconformably the calciferous sandrock of Eaton, then follows the sparry limerock of the same author, with some fossils peculiar to it; above that the limestones and shales of the Trenton series, several hundred feet thick, and then the Salmon river sandstone follows in the ascending order. This shows the great danger of error in endeavoring to identify strata over large areas, if we neglect to appeal to the evidence afforded by palæontology, and rely too exclusively upon the ever varying mineral composition of rocks, which it is obvious may present similar features in groups of widely different age.

The present grand undulations or inclined planes of the surface of the United States, considered in reference to their broader outlines, are owing to the position which the transition have been compelled to assume, by the unequal rise of primary chains. This has arisen from its vast aggregate thickness and enormous uninterrupted extent. Beginning, as it does, on the border of the Arctic sea, it extends, in some parts of its range, unbroken by granite peaks, quite to the center of Alabama, while it extends east and west, from the Appalachian chain to Engineer cantonment on the Missouri river. It, therefore, on a rough estimate, will be two thousand four hundred miles north and south by one thousand four hundred in extent east and west.

The upheaving force, acting over so vast an area, has only next the mountain chains greatly disturbed and inclined the strata, leaving the mass nearly horizontal to the eye, but rising and falling in enormously extended, slightly inclined planes and undulations. It is to the re-entering angles or synclinal lines of the planes that we owe the course of many of our large rivers. East of Little Falls on the Mohawk, that river runs many miles in a depression caused by the gentle dip of the strata on the north bank, and their gentle rise on the south. The St. Lawrence flows in a profound synclinal line, as may be seen by reference to Mr. Emmons' section in the New York geological reports for this year. Dr. Hildreth informs us, that the formations in Ohio dip towards the center of the valley of the Ohio river, and as they reappear at higher levels in Kentucky, there can be no doubt a synclinal line has determined the original course of that river.

These same formations extend through Indiana and Illinois to the Mississippi river, with a gentle southwest inclination; but as we ascend the Missouri, we find the strata rise with the elevation of the land, or slightly dipping to the east. Thus the Mississippi flows in a grand depression formed by the rise of the Appalachian chain on the east, and the Rocky Mountains on the west, a synclinal line, that for the enormous tract of country it occupies, and the vast extent of the two inclined planes of which it is the point of greatest depression, has no equal on the globe. To this fortunate geological feature of the country, we owe the gigantic scale of the rivers, sweeping thousands of miles through level and fertile regions, and offering to industry and enterprise sources of national wealth and prosperity, far surpassing any in the records of history.

The immense tract of country which lies between the Mississippi and the Rocky Mountains, owes its eastward inclination to the uplift of that chain, which has risen in the secondary and tertiary eras to a much greater elevation than the Appalachian range, and consequently raising the cretaceous formations, which abound high up the Missouri, to a much higher level than they attain on the Atlantic coast. This was caused solely by the rise of the Rocky Mountains, and not assisted by a depression along the eastern coast, as Elie de Beaumont supposes, because the occurrence of three tertiary deposits along that line proves, that so far from a depression having there taken place, the land has actually been upheaved, at the same time that the tertiary rose on the shore of the Pacific. This proves that the Appalachian and Rocky Mountain chains rose simultaneously to a certain degree in the upper tertiary era, and therefore it is not to a *see-saw* motion of the earth's crust that I would attribute the greater elevation of the cretaceous strata towards the Rocky Mountains, but to a more rapid uplift of that chain than has taken place in the Appalachian range. The greatest elevation of the latter during the upper tertiary period seems to have been between two hundred and three hundred feet, and this only in the northern part of the United States, as in the middle and southern States, this newest tertiary, which gives the maximum of elevation we have stated, does not attain more than ten or fifteen feet above the level of the sea. On the coast of California, Mr. Nuttall found shells of recent species two hundred feet above the sea. These are so much more remote from the axis of elevation than the tertiary shells of New York, that the uplift of the Rocky Mountains must have been far greater during the upper tertiary period than was any part of the Atlantic chain.

I know not what reason can be given for considering the whole of the transition as one group, as Mr. Rogers has done, when with very few exceptions the inhabitants of the seas have been destroyed and new creatures succeeded at five distinct epochs, and one of these groups is no more to be compared with another, than is the oolite with the green sand formation; yet each of these belongs to a different group in all the systems of geology hitherto published. The term, lower secondary, applied by the same geologist to the transition system, is equally objectionable, as it has scarcely a single feature in common with what has hitherto been termed secondary by all other geologists, and constitutes an order, not a single series of strata linked together by palæontological affinities. The term, lower secondary, would be far more appropriately given to the strata comprising the magnesian limestone, lias, oolite, &c. as upper secondary has been generally used to designate the cretaceous group.

### *Organic Remains of the Transition.*

No remains of reptiles, nor any impressions of the feet of birds or of reptiles, have been found in any of the trilobite rocks of the United States; but fucoids or marine plants abound in the sandstones, many of which have a digitate or trilobed form, and by the aid of the imagination could be readily converted into *ornithichnites*, or reptile trails. I am far from an intention to discredit the science established by Professor Hitchcock, as his descriptions apply to more recent strata than the transition, and which I have never studied, and his arguments are too ingenious for me to doubt; but I must be permitted to challenge his *ornithichnite*, of which even he is doubtful, in the graywacke of the Hudson river,* one of the oldest transition rocks in New York, deposited at a period so early that scarcely any small islands dotted the boundless waste of waters, and they consisted of naked primary rocks, bearing neither herb nor animal life.

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* Mr. Hitchcock has nowhere maintained the existence of an ornithichnite in the graywacke of Hudson valley; he found an impression there, having some slight resemblance to the footmarks of the Connecticut valley, and he called this tetrapodichnite, expressing at the same time strong doubts whether it were a real footmark.—Editors.

Remains of fish and their coprolites are occasionally found in the middle and upper portions of the transition, but the most distinguishing feature in the palæontology of the system, are the trilobites in nearly all the strata; the vast proportion of Brachiopods among the testacea, consisting chiefly of the genera *Orthis*, *Delthyris*, and *Strophomena* or LEPTŒNA, in the limestones; gigantic quadrangular fucoids in the sandstones, and small linear leaf-like fucoids in the slates. These latter first appeared in the lower slates, where other organic remains are very rare, but occasionally trilobites and shells of the genus Strophomena have been found, a fact which induces me to believe that these two orders were twin-born of the primeval seas, and that they were preceded by vegetable life. Mr. Phillips, in his investigation of the English equivalents, has been led to a different conclusion; but England is a limited theatre for the display of the order of succession, which sinks into insignificance in comparison with the colossal development of the transition in North America. Mr. Phillips observes, "the classes of mollusca are more ancient than those of *zoöphyta*, if we trust our present knowledge, and both older than marine or land plants."* We have, it is true, as yet no knowledge of *zoophyta* in the lower slates, and therefore the *testacea* may be more ancient than they, but marine plants are older than either.

Among the brachiopodous bivalves, the genus *Strophomena* of Rafinesque is the most characteristic of the trilobite system. *Producta* has as yet been found only in the upper term, or pyritiferous rocks of Eaton, where the species are very few and rare. In the mountain limestone above, *Strophomena* is hardly known, but it is crowded with Producta of many species. The latter genus, therefore, eminently characterizes the carboniferous system, with which it ceased to exist. Not a single species of *Terebratula* occurs in the Silurian system of this country, nor have I seen one from the carboniferous; the shells hitherto classed in that genus being referrible to *Orthis*.

Throughout the transition, we very rarely find any evidence of fresh-water streams or lakes; which is doubtless owing to the very small proportion of dry land in those periods. The first trace of them in New York is in the red sandstone at Medina, in Orleans county. They seem to have existed in a small lake, in a basin of some primary island, which was finally drained off by no violent current into the sea. This lake probably occurred in Canada, since Mr. Hall has clearly proved that the current came from the north, bringing with it fine sand, and running over a bed of marine shells, (*Lingula cuneata,*) which were moored by their long peduncles in the sand, and therefore all range in one direction, nearly north and south, reminding one of boats riding at anchor in a strong tide.

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* Treatise on Geology, p. 289.

I am unacquainted with any other trace of ancient fresh-water shells in the transition, except in the carboniferous system, where Unios are not uncommon; but it is remarkable that we do not find any which existed after this period, when there was so great an extent of dry land, especially in the tertiary epochs, except those which Dr. Hildreth discovered in Ohio. These consist of ferruginous casts of Unios, approximating in their forms to existing species of that region, and have every appearance of being of no older date than the upper tertiary; but it would be wrong to give a decided opinion of their age without further investigation of their relative position and analogy to existing types. Fresh-water shells, found in the calcareous deposits of modern lakes, and even where the water has disappeared, and the basins filled up with sand, covered by the soil and original forests of the country, all correspond with recent species living in the waters of the vicinity; and these marls, and even the monuments of filled up lakes, are common throughout the state of New York.

One of the most interesting features of the transition is derived from the ripple marks, which are generally most conspicuous on the sandstones, but occur also on the slates; one of the most beautiful examples of this action of the waters in shoal places upon the unconsolidated materials of rocks, may be seen at the slate quarry on the Delaware river above Easton. The stratum dips at a considerable angle. Such appearances are common in Europe, and have been noticed in New York, Pennsylvania, Virginia, and Ohio. They are records of the ancient condition of the globe, not easily misinterpreted. If there was scarcely any dry land at that period, it follows that the universal ocean was very shallow, its bed even, and the currents, except during the oscillations of the crust, by no means violent; hence, in their course over incoherent sand, they left their impress upon it so distinctly, that it is very easy to estimate the comparative force of currents on different strata by the larger or smaller undulations they have left behind. One can form an idea of the extent of one of these ancient floors of the ocean, when he sees the ripple marks, the same rock in mineral composition, and the same organic remains in Germany or Wales that he finds in New York; and can imagine how mighty a revolution the crust of the globe must have undergone to gain the vast depth of the Atlantic and the elevation of the Andes.

While on the subject of the transition, it may be useful to inquire into the relative position of a sandstone which seems at present little understood. It appears on the Hudson, near Newburg, and passes under the Palisadoes, reappears in New Jersey and Pennsylvania, following the course of the Delaware a distance of many miles, and disappears near Trenton, in New Jersey, where it rests unconformably upon gneiss. The color of this rock is generally red, very often with pale waved and concentric stripes; organic remains are very rare, one or two species of fucoids being all that I could find, and they differ from those of any other formation. This sandstone has sometimes been confounded with that of Western New York, a gross error, arising from its general resemblance to the latter. Mr. M'Clure regards it as a distinct formation, but terms it old red sandstone. It appears to me to be intimately connected with the Hudson river slaty graywacke, probably one passing into the other; but at all events it alternates with Eaton's calciferons sandrock near Easton, a character which identifies it at once with the Potsdam and Essex sandstone, described by Professor Emmons as occurring in the northeastern section of New York. In all cases it rests upon primary rocks and is the oldest of the fossiliferous formations, being under the calciferous sandrock, and occupying the same position in the geological series as the Cambrian system of Wales, described by Mr. Sedgwick. The copper mines of Flemington, in New Jersey, belong to this formation. The harder layers make excellent building stone, and of this rock the Penitentiary near Trenton is constructed. In New York it is one of the most common materials for door steps and basements, and it is occasionally used as a building material in Philadelphia, where it is brought down the Schuylkill river.

### *Remarks by the Editors.*

In relation to the difference of opinion between Mr. Conrad and Prof. Henry D. Rogers, we take leave to state, that having been occasionally in communication on geological subjects with the last named gentleman, and knowing his opinions in the present case, we presume our much respected correspondent, Mr. Conrad, (with whose able communications this Journal has been, from time to time, enriched,) will be gratified to know the grounds on which Professor Rogers differs from him. Should that gentleman choose to give his own explanations, this Journal is, of course, open to his communications, and should Mr. Conrad wish it, to his rejoinder; but in the mean time, the public confidence in both gentlemen will be increased by being informed, that the peculiar opinions of each are sustained by appropriate and important reasons; and it is, moreover, very desirable, that our geologists should understand each other.

We proceed then to state, that Professor Rogers, as we have understood from himself, has examined, with considerable care, the localities designated by Professor Eaton, where the "graywacke of the Hudson" is said to be highly inclined, and to have the "calciferous sandrock" resting unconformably on its edges; and that he has left these places fully satisfied, that the strata, supposed to belong to two formations of distinct epochs, are, in reality, but adjacent beds of one great formation, differing in mineral character, and seeming, at first glance, to meet unconformably, in consequence of the numerous local irregularities of dip, so common to this rock on the Hudson. In other words, he regards the calciferous sandrock of Eaton, (the first formation of his report,) as every where lower in geological order, than this so called graywacke, which has been traced uninterrupted from the Hudson, through New York, New Jersey, Pennsylvania, and the States further South as far as Tennessee, every where occupying the *third* place in the ascending series.

He supposes he has evidence to show, that a geological section, corresponding with a line drawn from the mouth of the Susquehanna river, a little east of north, through Pennsylvania and New York, to the country of primary rocks, north of Utica, would represent the entire series of thirteen formations, described in his report as occurring in exactly the same order, whether they are traced from the uppermost, (the anthracite coal formation,) southward, towards tide water, or northward, to the end of the section in New York; and in no instance, in either half of the line, was evidence observed of any want of conformity between adjacent strata. Such a section, where it crossed the Kittatinny Valley, would display the calciferous sandrock of Eaton, *underlying conformably* the metalliferous limerock of the same author, and this in turn underlying conformably the graywacke of the Hudson, while near its northern extremity it would exhibit the calciferous sandrock in conformable position below the limestone of Trenton Falls, and this again in similar relation, passing under the foundation of the Salmon river. That such is the state of things, Professor Rogers appears to feel satisfied from a careful study of the country around both the southern and northern ends of this supposed section. He therefore regards the so named graywacke of the Hudson as the same with the gray sandstone formation of Oswego county. He considers the argument based on the want of identity in the fossils as inconclusive, until it shall appear that a large number of species from each formation have been compared, and this because he places more confidence in conclusions drawn from following the rocks themselves over wide areas of country, (the only mode by which their true order of superposition can be first established,) than in inferences based upon the organic remains, the *true significance* of which can never be known until large groups of species are studied, and until the order of superposition of the strata, the very matter under discussion, shall have been previously settled by independent explorations.

## ART. V.—*Magneto-Electric and Electro-Magnetic Apparatus and Experiments;* by CHARLES G. PAGE, M. D., Washington City.

FROM the splendor of the sparks, and the extreme intensity of shocks obtained from magnetic electrical instruments where the galvanic battery is used as a source of the magnetic power, the hope has been entertained by many, that such instruments, would prove valuable in a high degree as sources of electrolytic power. The present infantile state of the science, shows clearly the futility of such a hope, and points directly to an arrangement which will place in the hands of the operator an instrument surpassing entirely the great galvanic battery in value and power. Such an instrument is the magneto-electric machine. The instrument described in the last April* number of this Journal demonstrates, by careful experiment with Faraday's volta-electrometer, that the electrolytic power of the current from the combined armatures is just double that of one. The avenue, then, to an indefinite power, is too obvious to escape notice. Increase the number of pairs of magnets, extend the series of armatures upon the same shaft, or in any way in which they may be brought to bear on the same terminal pole, and I hazard nothing in the assertion, that for the same prime cord, and contained in the same space, a magneto-electric instrument can be made of equal power to a galvanic battery of one thousand pairs of plates. It is evident, that there will not be that rapid diminution with the extension of the series which obtains in the galvanic arrangement, for in the magneto-electric machine the whole route of the current is through solid conductors, and in the galvanic battery, through a great extent of liquid and numerous soldered and imperfect joints. Nothing but the want of means has restrained me from erecting a magneto-electric machine, which I feel confident would rival the largest galvanic battery in existence. The arch of light would be obtained by disposing one set of armatures at right angles to the other, so that while one gave a diminishing current, the other would afford a current increasing in the same ratio; while one set was in the *neutral plane*, the other would be at the point of strongest action.

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* Vol. xxxiv, p. 163.

Having asserted thus much of the magneto-electric machine, it will be necessary to allude briefly to the objections to machines for electrolytic uses, where the galvanic battery is the *primum mobile.*

*First.*—The opposing currents produced by making and breaking the battery circuit cannot be separated, or rather cannot be united to form one current. In the magneto-electric machine, the alternating currents are made to flow in the same direction by the *pole changer*, or more properly in this connection, the *unitrep.* As it is desirable that every distinct and useful apparatus should have an appropriate name, I have selected the term *Unitrep*, as short, and descriptive of the use of this part of the magneto-electric machine. This important addition to the machine appears to be beyond simplification, consisting merely of two nearly half cylindrical pieces of metal, rivetted or secured in any manner to the circumference of a small disc of wood or ivory, and insulated from each other. Its use, as the name Unitrep implies, is to convert, or turn contrary currents into one common channel.

*Secondly.*—In the *galvanic* magneto-electrical machines, electro-chemical effects can be obtained (to any considerable degree) only by distinct impulses, occurring at each rupture of the circuit. These impulses or secondary currents closely resemble a common electrical discharge, and are of too short duration to allow the particles of the substances to be decomposed to assume definite polar arrangement. Nor can the circuit be broken rapidly to any advantage; for in the first place, the full magnetization of the iron requires appreciable time, and, secondly, the flowing of the secondary through a completed circuit, weakens itself by re-magnetizing the bar: (this will be spoken of in future.) In the *pure* magneto-electric machine, water is decomposed far more rapidly by the continuous current than by breaking the circuit, by the primitive than the secondary current. The secondary furnishes the most powerful shocks; but the primitive possesses the greatest decomposing power.

## *Compound Electro-Magnet and Electrotome for Shocks, Sparks, &c.*

In the late numbers of Sturgeon's Annals, I notice that Mr. Bachoffner has introduced the bundle of wires as superior to the solid bar for reaction upon the *coil wires.* Mr. Bachoffner probably used this compound arrangement before myself, as I made the discovery February 14th, 1838. Mr. Bachoffner remarks, "that it is necessary to insulate the wires of the bundle, and that it is difficult to understand their action, as the magnetic power is not so great as that of a solid bar." In every experiment hitherto tried, I have invariably found the magnetic power to be greater than that of a solid bar of the same weight. I have never found it necessary to insulate the wires to insure their operation, although I would not say that a very careful insulation might not improve their operation. For I apprehend that in the development and return of magnetic forces, electrical currents are excited in the body of the magnet at right angles to its axis, as well as in the wires surrounding the magnet. In this case the exterior portion of the magnet would act as a *closed circuit* upon the interior.

By a closed circuit is meant a FLOWING secondary current, which has the effect to re-magnetize the bar after the primitive battery current has ceased to act. That the operation of these *secondary closed circuits* has never yet been considered in the construction of machines, will appear from the following facts and practical observations.

*First.*—Enclosing a compound* electro-magnet in a tube of metal, almost entirely prevents the formation of secondary currents in the exterior wires, although by this arrangement the magnetic power is not perceptibly affected, with the exception, that its development requires *more time.*† The short and complete right angle currents in the metallic casing have a greater magnetizing power than the secondary of an extended and oblique coil of wire. Hence, after the battery current ceases, the chief portion of the secondary will flow in this short circuit, and the magnetism of the bar be prolonged to a perceptible degree, and if it were possible to break this *closed circuit* immediately after the battery circuit, a secondary and *tertiary* current would be observed from the coil of wire. This *tertiary* circuit I have perceived in another way.

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* Or a common single magnet.

† The increase of time necessary to effect the full development of magnetism, is due to the formation of the initial secondary flowing against the battery current.

*Secondly.*—Insulate the metallic casing from the magnet, and divide it throughout its length, so that the secondaries cannot pass, and the coil wire will now exhibit the full power of the secondary.

*Thirdly.*—Surround an electro-magnet with an entire metallic casing, *exterior* to the coil wires, and the secondary of the wires will be depreciated as before. Split the casing as before, and the secondary will again have full power.

*Fourthly.*—Brass rings or straps surrounding the poles of magnets or armatures for magneto-electric experiments, detract from their value by the action of *closed circuits.*

*Fifthly.*—The brass cheeks which are frequently used upon the armatures of magneto-electric machines for supporting the coil wires, materially impair the power of such machines. These cheeks should in all cases be made of wood, ivory, or some non-conducting substance.

*Sixthly.*—A metallic casing which entirely envelops a U magnet or armature, cannot convey closed circuits, as each half of the casing would transmit currents in opposite directions. Consequently, (as I have proved by repeated experiments,) the secondary of the coiled wire is not in the least impaired by this arrangement.

The following experiments were tried with a view to ascertain if electrical currents were excited in the body of the magnet itself. A hollow magnet was wound and tried; the secondary current was not so great as that from a solid bar of the same diameter. Singular as it might at first sight appear, the insertion or filling up of this hollow magnet with a rod of soft iron or a bundle of iron wires, did not in the least exalt the force of the secondary. This result accords exactly with that of a similar experiment by Mr. Bachoffner. I then rolled upon a cylinder of wood a piece of sheet iron, not permitting its edges to meet. It was then surrounded with three layers of coiled wire and tried, and the augmentation of the secondary was greater than that produced by the entire hollow magnet, which was of much thicker metal. But when the cylinder of wood was withdrawn, and its place supplied with a bundle of fine iron wires, the secondary was increased to a very great degree, and the whole appeared to be equally powerful with a compound magnet of the same size. It should be observed particularly, that when the hollow magnet was *entire*, the insertion of an iron rod or bundle of wires produced no effect. From these experiments I think the existence of secondary currents flowing in the body of the magnet may be very plausibly inferred. If actually determined, the fact would prove important, and is well worth pursuing. I soldered two wires to the edges of the enclosed sheet of iron, and connected them with a galvanoscope, but could not perceive any effect upon the needle. But as the instrument was by no means delicate, the experiment may be regarded as valueless. Having no opportunities at present of pursuing the investigation, I hope that the subject may receive due attention from those who may be interested.

The following striking experiments afford still further illustration of the action of closed secondary circuits.

*Experiment 1st.*—Place a straight electro-magnet upon a large flat spiral of copper, in the direction of a radius of the spiral. When the spiral is connected with the battery, the magnet becomes charged, and a secondary current in its wires is the consequence. Break the battery connexion with the spiral, and examine by the common tests the power of the secondary from the magnet. Again, break the circuit from mercury covered with oil, and the secondary from the magnet will now be found stronger than in the first case. When the circuit is broken over clean mercury, the secondary flowing through the heated vapor and air, acts as a closed circuit to prolong the magnetism of the spiral, and thus prevent a sudden and entire influence upon the magnet. When the mercury is covered with oil the secondary is arrested, and the magnetism suddenly ceasing, exerts its whole influence upon the magnet, or rather the magnetism of the bar ceases with that of the spiral. The same phenomenon is well illustrated by the electro-magnet alone, where the fine wire is independent of the large.

*Experiment 2d.*—The reciprocal action of the closed circuit of the magnet itself upon the secondary of the spiral is more remarkable. Break the battery connexion with the spiral over clean mercury, when the ends of the wire on the magnet are disjoined, and observe the spark; join now the ends of the magnet wire, and on breaking the battery circuit the spark from the spiral will be diminished. The manner in which the closed circuit operates here, will be more easily understood from, *Experiment 3d.*—Bring one extremity of the magnet used in the foregoing experiment in contact with one pole of the magnet of a common magneto-electric machine. As this disguises a portion of the magnetism, the amount of electricity developed by the revolution of the armature will of course be diminished. While working the machine the magnetic state of the electro-magnet will vary with the approximation and recession of the armature, and a current of electricity in its wires will be the consequence. When the current from the armature is broken or not suffered to flow at all, the current from the electro-magnet will be much stronger than when the circuit from the armature is constantly complete. When the armature is leaving the magnet, the flowing current or *closed circuit* magnetizes the armature and consequently disguises more of the power of the inducing magnet, than when the armature leaves without the closing of the circuit. The consequence is a detraction of magnetic power from the electro-magnet. Also, breaking the circuit from the armature under oil, increases the current from the electro-magnet.

*Experiment 4th.*—Join the ends of the wire coiled on one leg of the curved armature of a common magneto-electric machine, and allow the coil from the other leg to be connected with the break piece, as usual. As long as the circuit of the first coil is closed, the second coil will furnish scarcely any electricity; but when the circuit of the first coil is opened, the second furnishes nearly as much electricity as the combined current from both coils. This singular fact first called my attention to the great advantage of short, straight armatures, for the magneto-electric machine. Obviously, the best arrangement for straight armatures, would be that wherein they revolved between the ends of the magnetic poles, the axis or shaft being parallel to the legs of the magnets. The points gained by this plan would be, a more uniform and powerful current, and an exact division by the Unitrep of the semicircular routes through which the alternating currents are developed. In the machine described in Vol. xxxiv, p. 164, of this Journal, and in all others where the axis of motion is perpendicular to the plane of the magnet, if the two routes in which the opposite currents are developed be represented by two arcs of a circle drawn through the two neutral points, that arc towards the bend of the magnet will be much the longer, and represents a feebler current than the shorter arc. The only objection to this arrangement is the extra room it requires.

Figure 1.

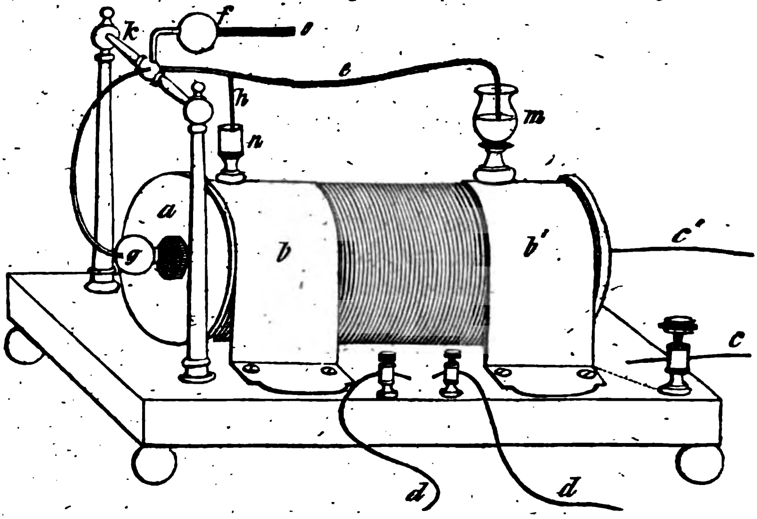


Figure 1, represents a new form of apparatus, consisting of a compound electro-magnet and electrotome; completed April, 1838. *a*, is an ivory cheek or head, through the center of which appear the extremities of the wires composing the magnet. *b*, *b′*, two brass straps confining the magnet to the base board. *c*, *c′*, the battery connexion for the large wires, which are terminally soldered to the cups with the binding screws, the soldered connexion being underneath the base board. *d*, *d*, are the fine wire terminations, the solderings being out of sight, underneath the base board. The movable part of the apparatus, *e*, *f*, *g*, *h*, *k*, is the electrotome. *e*, is a stout copper wire, passing through the shaft *k*. One extremity of this wire dips into the mercury cup, (*m*,) the top of which is of glass for exhibiting the spark; the base of brass is soldered to the brass strap *b′*. At the other extremity of *e*, is a small ball of iron, (*g*,) which, being attracted by the magnet, gives motion to the electrotome. It is proper to remark here, that the sphere of iron, *g*, is not attracted by the magnet with the same force as would be a piece of iron of ovoid form, or what would prove still better, a cylindrical piece, the length of whose axis was considerably greater than its diameter.

*h*, is a short piece of copper wire soldered to *e*, and descending into the mercury cup *n*, which is soldered to the brass strap *b*. The brass ball *f*, is movable on the projecting screw *o*, and serves as a regulator to the vibrations of the electrotome. The circuit traversed by the galvanic current is as follows. From the cup *c*, by the dotted line to the brass strap *b′*, thence through *m*, *e*, *h*, *n*, *b*, to one of the large wire terminations. The other termination of the large wires surrounding the magnet, is soldered to a cup connected with *c′*. When the galvanic circuit is completed, the magnet attracts the ball *g*, and raises *e* from *m*, producing a bright spark at *m*, and a powerful shock from *d*, *d*; *e*, then falls by its own weight, re-establishes the connexion, and thus the vibration continues. On the side of the ball *g*, towards the pole of the magnet, is fastened a piece of brass, or other non-magnetic substance, to prevent the adhesion of the ball to the magnet. The tips of the wires *h*, *m*, should be tinned before use. In all cases, tinning, or covering with soft solder the extremities of wires for connexions, and dipping them into mercury, will be found a much more preferable mode of amalgamating, than the usual practice of dipping them into nitrate of mercury, as they preserve their brightness a greater length of time.

### *Circular Galvanometers.*

Figures 2 and 3, represent two new forms of galvanometers, which are found to possess some advantages over other forms in common use. The whole appearance of this instrument, (though a trivial consideration,) is somewhat in its favor for purposes of general exhibition to a class. *a*, fig. 2, is the magnetic needle suspended by its centre on a fine point. The needle is made of watch spring, and bent into a form concentric with the coil *c*. The distance between the poles of the needle is about one sixteenth of an inch more than the width of the coil. The coil *c*, of insulated copper wire, is fastened by strong cement to the pillar *d*. *p*, *n*, are the terminations of the coil passing into the mercury cups on the stand. The coil is made of a number of strands of wire in lieu of a continuous wire. Galvanometer coils are usually made of too fine wire, and of a single wire of too great a length. M. Pouillet, in his late investigation of the general law of the intensity of currents, has shown that *derivation* made upon a primitive current from an elementary battery, strengthens

**Figures 2 and 3.**

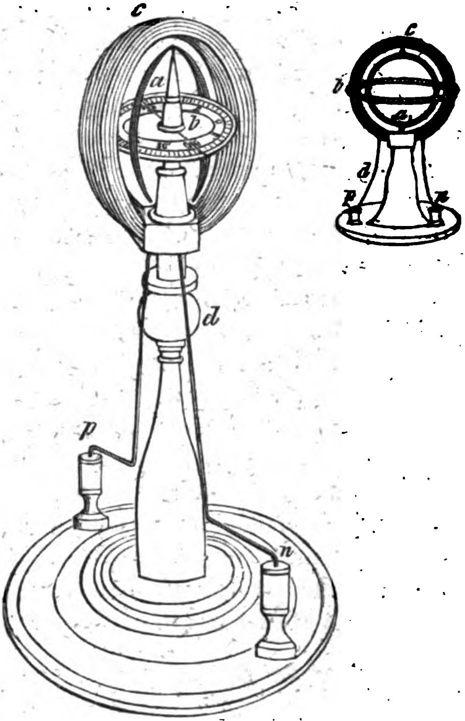
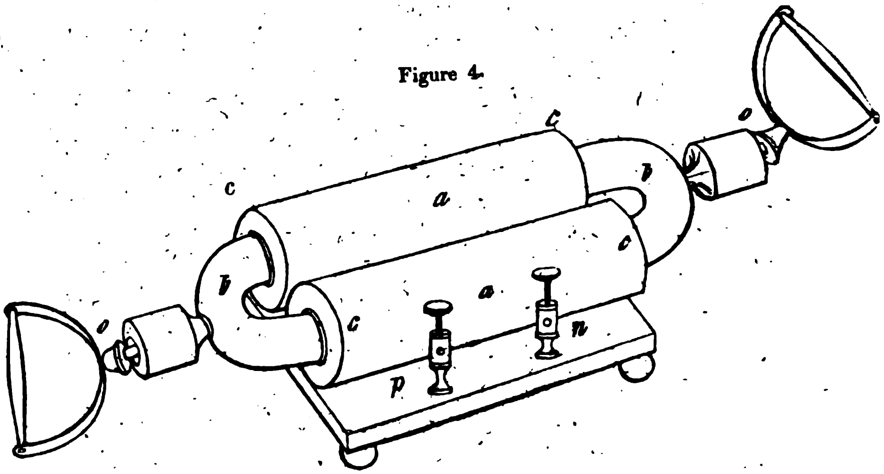


**Figure 4.**



that primitive current. By derivation is meant, the addition of another wire to any portion of the primitive circuit. The simple solution of the fact is, that derivation, or the addition of another wire, increases the conducting power of the circuit. Professor J. Henry's discovery of the method of increasing the power of the electro-magnet by winding upon it several short coils of wire, is a most striking practical illustration of this law. M. Pouillet has also arrived at the conclusion, that the intensity of the current produced by a single element, is in an inverse proportion to the real length of the circuit. The adoption of the several strands in the galvanometer seems therefore to be plainly indicated, and experiment fully warrants it. *b*, fig. 2, is a graduated circle of ivory for marking the deviations of the needle. Since the construction of the instrument, fig. 2, I have adopted the plan represented in fig. 3, which is much to be preferred on account of its simplicity of construction, and the perfect steadiness of the needle. *c*, is the coil cemented upon the stand *d*; *b*, a graduated zone surrounding the coil. *p* and *n*, the wire terminations. *a*, the circular needle of watch spring, with a very delicate upper bearing at *e*, and a slender pivot at *a*, resting upon an agate centre cemented to the coil. As this needle is not liable to any mechanical displacement, it may come very near the coil *c*. The portion of the circle between the two lines at *a*, which bears the pivot, is of brass.

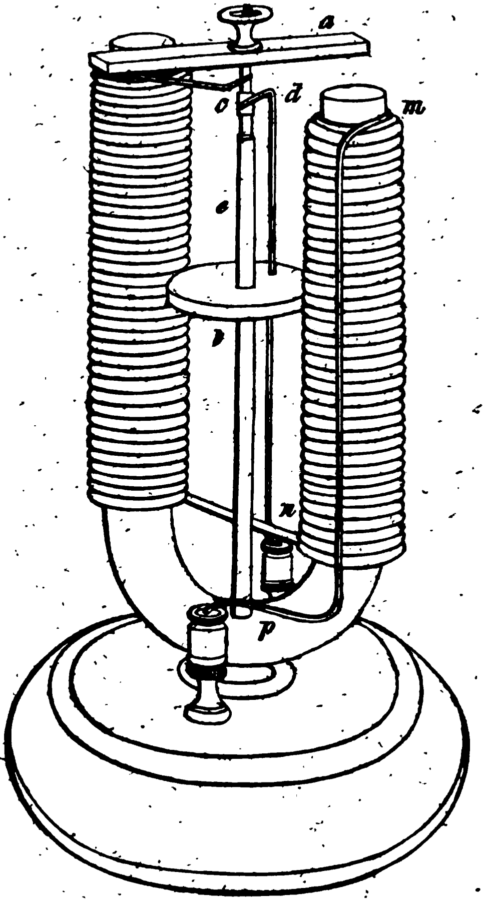
## *Double Helix for Inducing Magnetism.*

Figure 4, represents an apparatus contrived January 11th, 1838, for exhibiting the magnetic forces of the centre of the helix. *a*, *a*, are the two helices of five layers of wire, protected by brass casings, (split on the under side,) and by ivory heads, *c*, *c*, *c*, *c*. *b*, *b*, are two curved bars of soft iron which slide readily into the helices. *o*, *o'*, the handles for pulling, furnished with ball and socket joints at *o*, *o*, to prevent the magnets being twisted or wrenched. The wire terminations of the helices pass through the openings in the brass casings, underneath the base board, and are soldered to the screw cups *p*, *n*, for battery connexions. The attractive force manifested by this arrangement in the centre of the helices, is much greater than when an armature is applied at the extremities. A small apparatus of this kind will resist the strength of two stout men pulling by the handles. This makes a very pretty arrangement for a reciprocating electro-magnetic engine, there being no change of poles, as the motion is effected by an arrangement shown in the two next figures. This form of engine will be described in a future article.

### *Revolving Armature.*

Figure 5, represents an instrument invented in February, 1838, for exhibiting motion by magnetism without change of poles.

Figure 5.

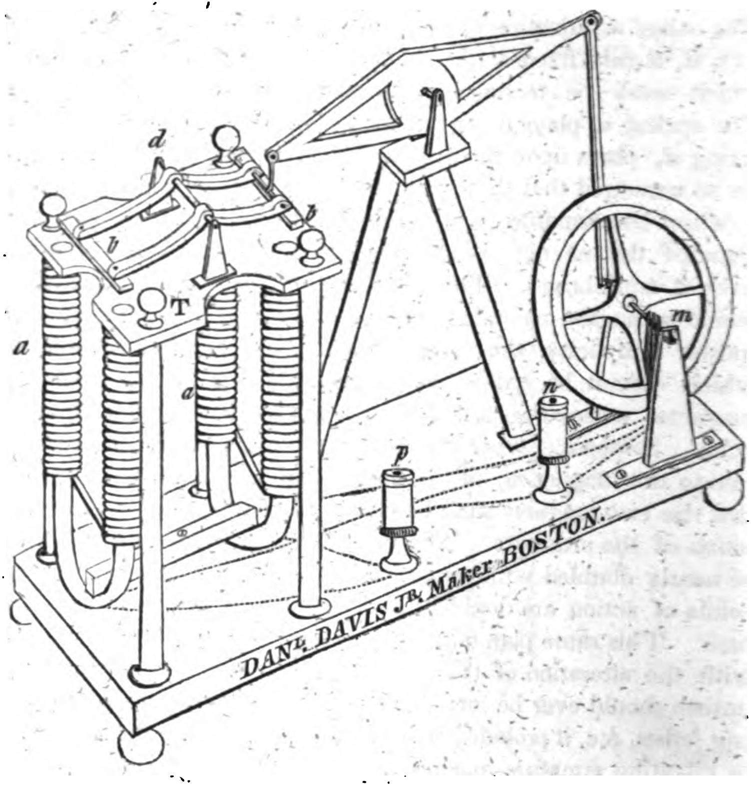


This instrument was the foundation of a series of experiments, made with reference to the mechanical application of magnetism, which will be published with drawings in a future communication. *m*, is the electro-magnet. *a*, the armature of soft iron. *e*, is an upright stem of brass, to receive and make the bearings of the shaft of the armature. *b*, is a disc of wood or ivory to brace the upright stem *e*. *c*, is one termination of the magnet coil, serving as a conducting spring. *d*, is the other conducting spring passing through the disc *b*, into the cup *n*, for battery connexion. The other termination of the magnet wires passes into the cup *p*. At *c*, *d*, firmly fixed to the shaft, is a cylindrical piece of silver, which may be technically called the *cut-off*, or electrotome. The spring *c*, plays upon the whole portion of the *cut-off*. The spring *d*, plays upon the dissected part, whose metallic divisions are so arranged that they shall come into contact with the spring *d*, when the armature is a little inclined from right angles to the plane of the magnet, and leave spring *d*, before the armature arrives at equilibrium. This armature revolves much faster than would a magnet changing its poles. Besides the advantage of greater simplicity, the *revolving armature* possesses advantages which cannot be gained by change of poles, or by revolving magnets, where the power is only cut off without a change of poles. Suppose another electro-magnet to be placed at right angles to the magnet *m*, in the figure, and the cut-off so arranged that the two magnets shall be charged in succession by the revolution of the armature. The velocity of the armature will thus be nearly doubled without the addition of more battery, for the points of action are doubled, and only one magnet charged at a time. This same plan admits of enlargement on any scale, only with the alteration of the mode of revolution. If electro-magnetism should ever be introduced for small powers, such as turning lathes, &c. it probably will be effected by either the revolving or vibrating armature machines.

### *Reciprocating Armature Engine.*

Figure 6, represents an electro-magnetic engine with vibrating or reciprocating armatures. *a*, *a*, are the electro-magnets, firmly secured to the base board and the wooden table *t*. *b*, *b*, are the armatures of soft iron connected with the shaft (*d*) by stout brass arms. The balance beam, connecting rods, and balance wheel, represented in the figure, require no particular description. The *cut-off* by which the magnets are alternately charged, is on the shaft of the balance wheel at *m*. It is simple in construction, made of silver, and similar to the one described for the revolving armature. There are three conducting springs tipped with silver, one playing upon the whole portion, and two upon the dissected portion of the *cut-off*. The connexions of the magnet

Figure 6.



wires with the springs and cups *p*, *n*, for battery connexion, are made under the base boards, and are marked by the dotted lines. Several of these engines have been made by Mr. Daniel Davis, Jr., philosophical instrument maker, of Boston; and are beautiful working models. As a proof that electro-magnetism is susceptible of useful application where only a small power is wanted, a small engine was made by Mr. Davis in the month of July last, by the aid of which, an individual gains fifteen dollars per day by the simple operation of drilling the steel plates for gas burners. I think this may be considered the first instance in which the mechanical application of electro-magnetism has been turned to profitable account. This engine is to undergo considerable alteration and improvement, when a description and drawing of it will be published.

That much remains yet to be determined concerning the most advantageous form and size of magnets and armatures, will appear from the following observations made during last October, while on a visit in Boston.

First: it is possible to present a piece of *soft iron* to the most powerful magnet in such a manner that it will not be attracted in the least by the magnet.

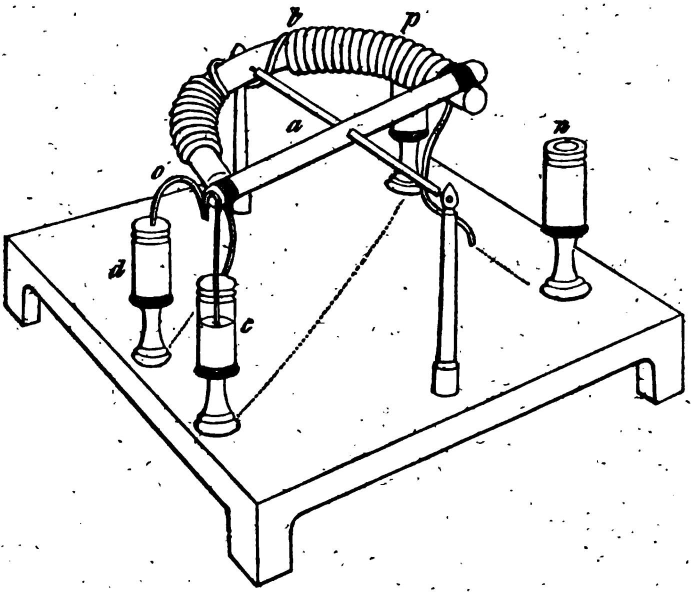
*Experiment.*—Drill a hole in the center of the pole of an electro or permanent magnet, to admit a small sliding rod of brass. To one end of this sliding rod, fasten a small disc of soft iron. The diameter of the disc must be less than that of the pole of the magnet, and the thickness or axis of the disc, must be considerably less than its own diameter. Put the sliding rod in its place, and if the disc of soft iron be exactly parallel to the face of the magnetic pole, it will not be attracted by it, be the magnet never so strong. If the disc is in the least inclined from parallelism, it will be attracted by the magnet. The experiment will appear more satisfactory if varied in the following manner. Place the disc of soft iron, with its sliding rod, in a frame, and place the magnet on a rest, so that its position can be varied; the same results will follow as before. Again: put the disc, without its silding rod, on the center of a large magnetic pole, and it will slip down to the edge of the pole, and there adhere. Again: sprinkle iron filings on a piece of paper laid over the end of a bar magnet; the filings will cluster over the pole around a vacant space at its center. Again: drill out the disc of iron so as to make a ring, whose width is greater than its thickness, and present it to the magnet in the same manner as the disc, and the ring will be attracted by the magnet. It appears from this, that the disc, though magnetized by induction is polarized in a radial direction, and the forces counteract, or disguise each other's influence upon the magnetic pole. When the diameter of the disc is greater than that of the magnetic pole, there cannot be this counterpoise of forces. When the disc is inclined to the face of the magnetic pole, it becomes polarized in the direction of an oblique line, joining that part of the disc in contact with the magnet, and that point most remote from the point of contact. These experiments throw some light upon a fact which, though long since known, does not seem to have been understood; viz. an armature which entirely subtends the poles of a U magnet, will not sustain so great a weight as one which covers only about one third of each pole. If the surface of the armature be flat, it will not be held so firmly, as if spherical, presenting much fewer points. If the armature be flat and broad, that portion over the pole may be considered in the light of the soft iron disc. Numerous holes in an armature do not sensibly interfere with its adhesion. A piece of soft iron was first suspended from a single pole, with just as much weight as it would hold. It then had several large holes drilled through it, taking away a large portion of its substance, and was again tried; the induced magnetic power appeared to be as great as through the entire piece. This doubtless would not be true to any extent, although the properties of the armature are not perceptibly affected by a hole through its center, yet if a steel, or soft iron rod, be passed through this hole, its inductibility will be greatly impaired. This fact should be particularly observed in the construction of magneto-electric, and electro-magnetic machines, where a steel, or iron shaft, is often allowed to pass through an armature or magnet. If, while the armature is suspended by one end to a single pole, a piece of soft steel is drawn through the hole in its center, the steel becomes properly and permanently polarized; but if, while the armature is thus in contact with the magnet, the steel rod be passed half its length through the hole, and examined in that situation, both its extremities will be found to be similar poles.

In the management of electro-magnetic engines, it is worth observing here, that a greater power is always obtained by using a compound, instead of a single battery, provided the series does not exceed two. As the elementary battery has always been considered as possessing the greatest dynamic, or magnetic power, this species of battery has been preferred for application to electro-magnetic machines. I have invariably found that two pairs of plates, arranged as a compound series, connected with an electro-magnetic engine, or any apparatus for electro-magnetic rotations, produce a velocity nearly double that given by the same surface used as an elementary battery. If the series extend beyond two, the magnetizing power diminishes, although the sparks at the break pieces are brighter. In all cases where motion is produced by the galvanic current, it must meet with considerable resistance, either from secondary currents or from the breaks in the circuit. The compound current probably has a greater velocity than an elementary current, and meets with less resistance from opposing secondaries and passing breaks.

### *Vibrating Armature.*

Figure 7, represents a vibrating armature, to be used as an electrotome, in connexion with an apparatus affording sparks or shocks. *b*, is a small electro-magnet, (of the actual size given in the figure,) and covered with only a single coil of wire, so as not to detract much from the power of the instrument with which it is used. *a*, a slender iron wire for an armature, suspended on a delicate shaft. *o*, is a connecting wire of copper fixed to one end of the armature, joining the mercury in the two cups *d* and *c*. *p* and *n*, are the terminal cups for connexions. The connexions between the cups and the ends of the magnet wire, are made under the base board, and marked by the dotted lines. The cup *c*, is of glass, or very thin ivory, to exhibit the illumination from

Figure 7.



the spark. When the battery circuit is complete through the instrument, the end *o*, of the armature is raised by the magnet, the connexion is broken at *c*, and the end *o*, falls by its weight, again rises, thus giving a rapid succession of sparks at *c*. The extremities of the armature are wound with a little sewing silk, or thread, to prevent their retention by the magnet.

Washington, November 13th, 1838.

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## ART. VI.—*Description of some new Shells*; by BENJAMIN TAPPAN, Steubenville, Ohio.

PROF. SILLIMAN,—I send for publication in the Journal of Science the following descriptions of some shells found in Ohio, which are believed to be new.

"UNIO SAYII, *Ward.* Plate III. Fig. 1.

Shell sub-rhomboidal, inequilateral, transverse, compressed; valves thin, beaks slightly prominent and *divergingly* wrinkled; cardinal teeth oblique, *single* in the right and *double* in the left valve; lateral teeth *slightly* curved; nacre white.

Hab. Walnut creek and Ohio canal, near Circleville. W. H. Price. My cabinet; cabinets of Dr. Kirtland, R. Buchannan, Esq., B. Tappan, A. Binney, Esq., Dr. Gould, Dr. Jay, Col. Totten, &c., &c.

Diam. 1. Length 1.60. Breadth 2.80.

Shell inequilateral, transverse, sub-rhomboidal, compressed; posterior and superior margins rectilinear, basal margin curved, anterior margin regularly rounded. Valves thin, translucent. Beaks slightly prominent, incurved and divergingly wrinkled, placed near the anterior margin. Umbonal slope sub-carinate, carina somewhat elevated. Ligament long, narrow, nearly straight and partially concealed. Epidermis pale yellow, inclining to cupreous on the umbos; glabrous, with indistinct capillary rays of a lighter color extending over the whole disk; lines of growth black, and very distinct; two faintly impressed lines diverging from under the points of the beaks and extending to the posterior basal margin. Cardinal teeth very oblique, not prominent, single in the right and double in the left valve, slightly crenate; lateral teeth lamellar, slightly curved. Anterior cicatrices distinct, posterior confluent, dorsal situated horizontally across the cavity of the beaks and distinct; cavity of the beaks shallow and rounded; nacre white, slightly iridescent over the entire surface of the valve, with faintly impressed striæ or rays diverging from the cavity of the beaks, and extending to the basal margin. Inhabitant unknown."

The above description is by Doct. Charles J. Ward, of Roscoe, Ohio.

"PALUDINA HETEROSTROPHA, *Kirtland.* Plate III. Fig. 2.

Sinistral, aperture more than half the length of the shell.

Shell sub-globose, ovate; spire depressed, apex generally truncate; whorls five; aperture ovate, with its superior extremity curved towards the body whorl, within bluish white; epidermis greenish horn color, usually coated with ferruginous clay. Length three quarters of an inch.

This shell frequently occurs in Mill and Yellow creeks, tributaries of the Mahoning river. I formerly considered it a mere variety of the P. decisa of Say; but on further examination find it to be specifically distinct. It never attains more than half the length of that species; its spire is never depressed, and it is always heterostrophal."

I am indebted to Doct. J. P. Kirtland for the foregoing description.

PHYSA SAYII, *nobis.* Plate III. Fig. 3.

Shell sinistral, ovate; color brownish yellow, or chestnut; whorls five; the first large, the others small, terminating in an acute dark brown apex; aperture large, four fifths of the length of the shell; translucent; length one inch, breadth seven tenths of an inch.

I first found this shell, May, 1837, in a small lake called Lake Pipin, which is situated about fifty rods from the Cuyahoga river, in Franklin township, Portage county, Ohio, (the same locality where was found the Anodonta Pipiniana of Lea.) All the shells of this species hitherto found were dead, although much time was spent in examining for live ones in May, 1837, and in June, 1838. A few only were found, and are in the cabinets of Mrs. Say, Doct. Kirtland, Doct. Ward, and myself.

The shell here published as the Unio Sayii, in honor of the first American conchologist, has been supposed by Mr. Lea to be "a middle aged *camptodon* of Say," and by Mr. Conrad and some others, to be the *declivis* of Say. Without entering into a minute comparison here, let those who have the Unios *camptodon* and *declivis* of Say and this shell, compare them with each other, and they will be compelled to agree that they are three distinct and well marked species. Those who have not the shells to compare, will arrive at the same conclusion, by a careful comparison of the drawings of the *declivis*, plate 35, of the American Conchology; of the *camptodon*, plate 42, of the same work; and the drawing, No. 1, herewith given: all by the same accurate and skillful hand. In general, the western conchologists adopt Mr. Lea's classification and nomenclature of the Naiades, with perhaps but one exception, the *mytiloides*, which they are not able to find in Rafinesque's MONOGRAPH. But in dissenting from his opinion in this instance, and calling the *Unio Sayii* a new and undescribed shell, the opinion of Dr. Ward is supported by all those conchologists; nor does it seem probable to them that Mr. Lea would have called it a *camptodon*, or Mr. Conrad and others a *declivis*, if they had carefully examined many specimens.

## ART. VII.—*On the employment of Uvularia perfoliata as a remedy for Poisoned Wounds*; by BENJAMIN HORNER COATES, M. D., Senior physician to the Pennsylvania Hospital.

**Read before the Philadelphia Academy of Natural Sciences, Aug. 14, 1838, as a communication, not intended for their Journal.**

WHILE at Pottsville, in July, 1838, I was called upon to visit a girl about five years of age, alleged to have been bitten by a rattlesnake, but as it afterwards appeared, probably by a copper-head, (Trigonocephalus contortrix.) When I saw the patient, three hours had elapsed; but the parent, an intelligent man, stated that the pain produced by the bite had greatly abated under the application of a plant obtained from the forest, and applied bruised and moistened with salted vinegar. Although crushed, the plant appeared on inspection, to be the Uvularia perfoliata; and its identity was afterwards verified by fresh specimens obtained for me by a gentleman attached to the Delaware coal company, but who has forbidden me to use his name. No other remedy of a nature calculated to diminish pain appeared to have been employed, unless a tight and hard ligature above the knee be considered such. This, however, appeared to me rather to increase than diminish the sufferings of the wounded individual. I apprehend, further, that the pain produced by the bite of a copper-head does not in general, terminate in so short a period as three hours, and that the amount of pain relieved exceeded that usually experienced from the application of cold and wet substances, as mud, &c. to envenomed stings. Under these circumstances, the case seemed to possess a certain weight in favor of the real usefulness of this antidote. The details of the narrative will be appended to the present notice.

The gentleman already alluded to, had known it to be previously employed in two cases with apparent success; in the first of which, it was applied by an old Indian to the bite of a rattlesnake near the shoulder of a boy.

I observe in the Medical Flora of Prof. Rafinesque, that the different species of Uvularia, particularly the perfoliata and grandiflora, are set down as "said to be equal to Hieracium nervosum [venosum] in bites of rattlesnakes;" and to the Hieracium he elsewhere (p. 228) gives a high character. I am ignorant from what sources Mr. Rafinesque derives his information relative to the powers of the Uvularia, unless it is from the following passages in Schœpf, p. 40: "*vis*,—maturans, aperiens: *usus*,—radix aquâ contusa ad vulnera Caudisonæ, aliaque vulnera et ulcera. Herbæ decoctum ad inflammationem oris, laryngis, tonsillarum." From its affinities, it may be reasonably supposed to possess active properties; Dr. Lindley placing it with Veratrum, Helonias and Colchicum, and Dr. Torrey, near Medeola and Trillium. When chewed, it afforded but little mucilage, with a bitterish taste, and produced a strong sialagogue effect, with a scarcely perceptible nausea.

Upon summing up this evidence I am induced to believe, that a certain degree of probability attaches to the ascription of remedial virtues to this plant in cases of envenomed wounds. If we add together the observations at Pottsville, the statements of Professor Rafinesque, and the botanical analogies, I can hardly feel willing to pass them by as unworthy of attention. We may further suggest the expediency of making trials of analogous plants so widely diffused among us, and so easy to obtain in larger quantities, as Veratrum viride, and Helonias lutea and dioica.

Case.—Mount Carbon, July 22: 2, P. M. Called to visit S. B., five years old, said to have been bitten by a rattlesnake. Dr. Wetherill politely accompanied me. According to her father, she was walking with him three hours previously, picking whortleberries, when the father trod on a snake, which immediately bit the child. On being questioned, the persons present acknowledged that the serpent in question was less than three feet long, that they had not heard it rattle, and that they had not killed it, and therefore had no opportunity of examining its appearance. As the effects of the bite were violent, it was presumed that it was inflicted by a copper-head, (Trigonocephalus contortrix, of Dr. Holbrook,) which was the only snake known in the vicinity likely to combine the above conditions.

A company who walked to the spot two days after, found the body of a copper-head in a state of decay, which might easily be attained in such an interval. It had been, notwithstanding the above statements, killed by a blow across the back, and was furnishing a repast to a number of large black beetles, observed to gnaw the bodies of snakes.

A strip of white ash bark was bound firmly round the limb above the knee; and at some subsequent period, a quantity of Uvularia perfoliata, bruised with vinegar and salt, was applied round the vicinity of the bite. Under this treatment the wound, at first intensely painful, became quite free from pain unless touched. It continued to feel numb.

The limb was enormously distended with an œdematous swelling, extending as high as the ligature; masses of effused blood were visible, deeply seated in the top of the foot and in several parts of the leg, particularly at the middle of the fore part. The skin was white, shining, and cold. One puncture only was visible, situated about two inches above the instep, and surrounded by a dark red circle. I could only explain the appearance of a single puncture by supposing, that the snake struck the child while disordered in its movements by the pressure of the parent's foot.

A cup was sent for, but when obtained proved too large to adhere to the limb. Suction was made forcibly by the bowl of a tobacco-pipe for half an hour; at the end of which time, several drops of blood had issued from the puncture, a little diluted with a serous fluid; and other blood had been effused from the indentation produced by the pipe, which was marked by a circular ecchymosis. We then discontinued the suction, fearing to disorganize the skin by its longer employment. Three doses of a strong and caustic aqua ammoniæ, amounting in all to about twenty drops, were given to the child, with milk; a paste of the same liquid with wheat flour, was applied over and around the wound, to the extent of about one and a quarter inches square. The ligature and Uvularia were continued.

At 4, P. M., the swelling was a little increased. No pain, however, was experienced when the part was not touched. The numbness was considerably increased, and the color much yellower. A slight increase of the frequency and volume of the pulse had taken place.

Continued applications. Gave five drops more of aqua ammoniæ.

6, P. M. Dr. Halberstadt met me at the house. Numbness and soreness abated. Color much more yellow; less redness; skin more opaque; swelling slightly increased. Coldness nearly as great. Omit ligature. Purge in the evening with salts.

9, P. M. Parents had continued the ligature through terror. Swelling, distress and restlessness increased.

Apprehended mortification. Ligature to be removed peremptorily.

23d. Ligature had been removed last evening. Patient had rested well. Cathartic had operated. Swelling diminished below the knee, but extended much nearer the body, beyond the mark of the ligature, to the terror of the parents. No fever. Ammoniacal paste had blistered smartly. Considered better. Poultice the blister with bread and milk. Continue Uvularia to uncovered parts. Sweat limb with hot vinegar steam.

Evening. Dr. Halberstadt informs me that the swelling did not visibly diminish, till the child was freely purged.

Wednesday, 25th: 5, A. M. Child runs about freely. No pain. Little inconvenience. Swelling greatly abated. Yellow color intense.

29th. Saw Dr. Halberstadt in Philadelphia. Child well.

With regard to the mortality of the bite of our venomous serpents, and the possibility of recovery from them by the unassisted powers of nature, the facts which have occurred or been communicated to me, tend strongly to prove the correctness of the position, that death rarely, if ever, takes place from the direst effects of the bite in human adults. Thus, that which is ascertained by Fontana with so much labor in regard to the viper, and rendered so probable by Russell, as to the cobra de capello and other celebrated Indian serpents, seems likely to be also established in regard to our rattlesnakes. This would hardly have been expected from a comparison made by the last named author, who states that a rattlesnake in London killed a dog in two minutes; while the shortest period of time in which Dr. R. was able to produce that effect by his strongest cobras, was thirteen minutes, or a period six and a-half times as long. Of our ten or twelve venomous serpents, it seems generally conceded, that the most powerful are the different species of Crotalus. Of these, Dr. M'Connell, of Mauch Chunk, communicated to me eleven years since, that he had then attended no less than *seventeen* bites; not one of which had proved fatal. Since that period, the Crotali have become less numerous in the vicinity, from the increase of population. Dr. M'C. has however, within his momentary recollection, seen three or four more, and has never seen a death. Similar results were met with at Pottsville, by Dr. Halberstadt; and the popular recollections I heard came to the same account, with the exception of one statement, of which I did not learn the details, that a man had some time previously died in two minutes, of a bite. Most probably, in this last case, the poison was instilled into a vein. I observe, that Mr. Daudin alledges that this venom is extremely formidable in the south, but that its terrors are singularly exaggerated in the north. That the exaggeration may also be found in another latitude, may be alledged upon the authority of our distinguished countryman, Dr. Holbrook; as whose opinion I am authorized to state, that the poison of the rattlesnake is mortal to animals of the size of its prey; but very rarely, if ever, to man. To observations so extensive as those of the gentlemen I have named, the addition of two more cases could only be worth making, from a desire to enlarge as far as possible the number of cases from which inferences are to be drawn. I have seen two such out of Philadelphia,* and both recovered.

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* After the above had been read to the Academy, William Hembel, Esq., favored me with a communication of so much interest, that, coming as it did from two

From these facts, it will be easy to explain the doubtful reputation of various remedies for the bites of our venomous serpents. Those enumerated by Daudin, seem to have been nearly all lost sight of by medical men and naturalists, with the exception of the Hieracium venosum. Perhaps most of our "snake roots," the Aristolochia serpentaria, Polygala senega, Cimicifuga racemosa, owe their cognomen to a similar source. Still, it was thought a duty to medical science to preserve and compare the apparent fact of the agency of a medicinal plant, to extend science and facilitate future inquiries. The appropriate method of treatment would seem to be nearly that pointed out by Fontana; viz. a moderately tight ligature, and suction, with some force and for a prolonged period. It must be conceded that the venom, unless removed by suction, is gradually absorbed into the general system; and that the real object of the ligature is not the impracticable purpose of preventing this, but that of allowing time enough for the gradual introduction of the poison by the capillaries, and its progressive removal by the emunctories. Finally, as two hours were found by Fontana to be sufficient with the viper, conjecture or analogy would probably allow us to consider our precautions against the rattlesnake as sufficient in six or seven hours. It will probably be still right for us to make further trial of antidotes; nor can any circumstance render useless, such varying treatment as the incidents of the case may call for in the mind of a discerning practitioner.

## Art. VIII.—*An Account of the Proceedings of the Eighth Meeting of the British Association for the Advancement of Science.*

The eighth meeting of this noble institution was held at Newcastle, during the week from the 20th to the 26th of August, 1838. The attendance was unusually large, and the interest excited was in no degree inferior to that exhibited on former occasions.

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such high authorities, it appeared to form too valuable an addition to the statements in the text to justify omission. Mr. Hembel and the late Professor Benjamin Smith Barton, made inquiries of a considerable number of Indian chiefs of repute, whether the bite of the rattlesnake was ever mortal among the natives. The reply was uniform, "that it was never mortal, because they had antidotes." The comments already made are perhaps sufficient.

The London *Athenæum*, (Nos. 565—568,) contains a copious and excellent Report of the doings of the meeting. It is impossible, in the limits within which other claims upon our pages compel us to bring this article, to give more than a condensed summary of that Report. We shall of course be obliged to pass with a bare mention, many of the papers, and to abridge others more than we could wish. We shall endeavor to lay before our readers those topics which fall more particularly within the province of this Journal.

The financial concerns of the Association are highly prosperous. On the 31st of July, 1838, its property amounted to £6812 18s. 1*d.*, viz. in books, £1000 7*s.* 6*d.*, and in stocks and cash on hand, £5812 10*s.* 7*d.* During the year, £932 2*s.* 2*d.* were expended for the prosecution of various scientific investigations.

As heretofore, the meeting was distributed into independent sections, holding distinct daily sessions.

The next meeting of the Association will be held at Birmingham, during the month of August, 1839.

### Section A. *Mathematical and Physical Science.*

It was reported to the section,

1. That the Committee appointed to represent to the Government the importance of reducing the *Greenwich Observations on the Moon*, had waited on the Chancellor of the Exchequer, and that the sum of £2000 had been appropriated for that purpose, which was placed at the disposal of the Astronomer Royal, who had undertaken to superintend the reductions.

2. That the reduction of the Stars, intended to form the *enlarged Catalogue of the Royal Astronomical Society*, was in progress;—and (3) also the reduction of the Stars in the *Histoire Celéste.*

4. That arrangements had been made and approved for the establishment of an *Observatory at Liverpool*, and would be carried into effect as soon as the necessary power could be obtained from Parliament.

### *Lieut. Col. Reid on Redfield's Law of Storms.*

Lieut. Col. Reid, R. E. then read "A Report explaining the Progress made towards developing the Law of Storms, and a

Statement of what seems desirable should be farther done to advance our knowledge of the subject."

Col. Reid commenced by stating that he had long been convinced that the operations of the Deity in the workings of his providential care over his creatures, were governed by fixed laws, designed by incomprehensible wisdom, arranged by supreme power, and tending to the most benevolent ends. However irregular the tempest or the tornado might appear to the inobservant, yet our own day had seen some of the phenomena reduced to rule; and he doubted not soon to convince the Section that we were on the eve of advancing some steps farther towards this most desirable end. His attention had been first directed to the subject in 1831. He arrived on military service, at Barbadoes, just after the desolating hurricane of that year, which, in the short space of seven hours, destroyed 1477 persons on that island alone. He had been for two years and a half daily employed as an engineer officer amidst the ruined buildings, and was thus naturally led to the consideration of the phenomena of hurricanes. The first explanation which to him seemed reasonable, he found in a pamphlet by William C. Redfield, of New York, extracted from the American Journal of Science, a work much less known in this country than its value and great merits deserved. The northeast storms on the coast of America had attracted the attention of Franklin. He had been prevented, by one of these storms, from observing an eclipse of the moon at Philadelphia, which he was soon after astonished to find had been seen in Boston, although that town lay to the northeast of Philadelphia. This was a circumstance not to be lost on such an inquiring mind as Franklin's: he ascertained, upon inquiry, that the same northeast storm had not reached Boston for some hours after it had blown at Philadelphia; and that, although the wind blew from the northeast, yet the progress of the entire storm was from the southwest. He died, however, before he had made any further progress in this investigation.* Col. Capper, of the East India Company's service, after having studied meteorological subjects for twenty years, in the Madras territory, published a work, in 1801, upon winds and monsoons, giving brief statements of their fatal effects, from Orme's History of Hindustan. In this work he states his belief that hurricanes will be found to be great whirlwinds; and says, "it would not perhaps be a matter of great difficulty to ascertain the situation of a ship in a whirlwind, by observing the strength and changes of the wind. If the changes are *sudden*, and the wind violent, in all probability the ship must be near the center of the vortex of the whirlwind; whereas, if the wind blows a great length of time from the same point, and the changes are gradual, it may reasonably be supposed that the ship is near the extremity of it." In this conjecture respecting the nature of hurricanes, Col. Reid conceived Col. Capper to be decidedly right, and the conclusion he drew from it has stood the test of close examination. Mr. Redfield, following up the observation of Franklin, and though probably unacquainted with the views or opinions of Capper, ascertained that while the northeast storms were blowing on the shores of America, the wind was with equal violence blowing a southwest storm in the Atlantic. Tracking Franklin's storms from the southward, he found, throughout their course, that the wind on opposite sides of the shore over which the storm prevailed, blew in opposite directions, and that in fact, *the entire storm was a progressive whirlwind, and that all these whirlwinds revolved constantly in the same direction.* In a No. of the American Journal of Science, (for 1831,) Col. Reid found collected together many records of the same storms, and a chart on a very small scale, showing the progress of one. Strongly impressed with the conviction that Mr. Redfield's views were correct, he determined to verify them by making charts on a large scale, and laying down on them the different reports of the directions of the wind at *points* given in the American Journal of Science: and the more exactly this was done, the nearer was the approximation to the tracks of a progressive whirlwind.* He then exhibited to the Section a volume,† containing eight charts on a large scale, of which the first and second chart contained the result of this part of the examination; and he explained how the arrows showing the direction of the wind at the several stations were all on the right hand side of the several circles flying from the south, while at the stations at the left hand, or towards the east of the chart, they were all coming from the north. After tracing a variety of storms in north latitudes, and being impressed with the regularity with which they appear to pass to the North Pole, and always revolved in the same direction, viz. opposite to the hands of a watch, or from the east round by the north, west, south and east,—he was led to conclude, that in accordance with the order of nature, storms in south latitudes would be found to revolve in a contrary direction to that which they take in the northern hemisphere. He earnestly sought for facts, to ascertain if this were the case, and had obtained much information confirmatory of the truth of the conjecture, before he was aware that Mr. Redfield had formed the same opinion. The general phenomena of these storms will be understood, if the storm, as a great whirlwind, be represented by a circle, whose center is made to progress along a curve, which generally approaches the parabolic, the circles expanding as they advance from the point at which the storm begins to be felt. He pointed out how his views were illustrated by the disastrous storm of 1809, experienced by the East India fleet, under the convoy of the *Culloden* line-of-battle ship, and the *Terpsichore* frigate, and four British men-of-war, which left the Cape of Good Hope, about the same time, intending to cruise about the Mauritius. Some of these vessels scudded and ran in the storm for days; some by lying-to, got almost immediately out of it, while others, by taking a wrong direction went into the heart of it, foundered, and were never heard of more; others, by sailing across the calm space, met the same storm in different parts of its progress and the wind blowing in opposite directions, and considered and spoke of it as two storms, which they encountered; while others, by cruising about within the bend of the curve, but, beyond the circle of the great whirl, escaped the storm altogether, which had been for days raging on all sides of them. This led him to draw the very important practical conclusion as to how a ship should act when she encountered a gale, so as to escape from it. By watching the mode of veering of the wind, the portion of a storm into which a ship is fall-

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* Franklin died in 1790, forty six years after he made this discovery.—Eds.

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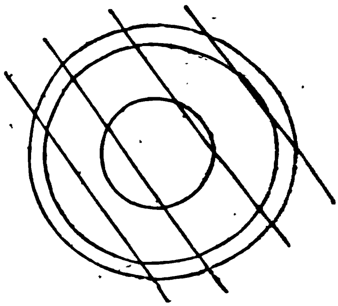
* Having, in consequence of our frequent intercourse with Mr. Redfield, been acquainted with the progress of his inquiries and discoveries, we may here state that the course adopted by Col. Reid, of plotting on a large chart, the various reports of a storm, had been employed many years previous, by Mr. R., and indeed led him to his most important conclusions. We may also mention that we are sure that Mr. R. has not to this day, seen Col. Capper's book, and that he was not aware of its existence until just before the reception of Col. Reid's work.—Eds.

† See a notice of this work, p. 183 of this volume.—Eds.



ing, may be ascertained; if the ship be then so manœuvred as that the wind shall veer aft instead of ahead, and the vessel is made to come up, instead of being allowed to break off, she will run out of the storm altogether; but, if the contrary course be taken, either through chance or ignorance, she goes right into the whirl, and runs a great risk of being suddenly taken aback, but most assuredly will meet the opposite wind in passing out through the whirl. To accomplish her object, he showed, by a diagram,* (as is above represented,) that it was necessary the ship should be laid on opposite tacks, on opposite sides of a storm, as may be understood by drawing a number of concentric circles to represent the whirl of the hurricane, and then different lines across these, to represent the course of ships entering into, or going through the storm; but to attempt the full explanation of even this, would extend much beyond our limits.

The apparent accordance of the force of storms with the law of magnetic intensity, as exhibited by Major Sabine's report, is remarkable. It had been frequently remarked that no storms occur at St. Helena. He had therefore felt much curiosity to know the degree of magnetic intensity there, and was not a little struck at finding it the lowest yet ascertained on the globe. Major Sabine's Isodynamic lines, to express less than unity, are only marked there, and they appear as it were to mark the *true* Pacific Ocean of the world. The lines of greatest intensity, on the contrary, seem to correspond with the localities of typhoons and hurricanes; for we find the meridian of the American magnetic pole passing not far from the Caribbean sea, and that of the Siberian pole through the China sea.

Prof. A. D. Bache, of Philadelphia, stated that he rose to thank Col. Reid, for the very handsome manner in which he had brought forward the theory of his countryman, Mr. Redfield.

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* A diagram similar to this, but in some respects more full and explicit, together with a discussion of the methods of escaping a storm, was given by Mr. Redfield in Vol. XXXI, p. 117, of this Journal.—Eds.

Having done this justice to one of his countrymen, Prof. B. remarked, that he was sure Col. Reid would follow it up by an examination of a rival theory of storms, by Mr. James P. Espy of Philadelphia. In this theory, the wind was supposed to blow in all directions towards the center of the storm; and a large collection of observations had been brought by Mr. Espy to form this point, especially those at his command from various quarters of the United States, as Chairman of the Committee of Meteorology of the American Philosophical Society, and the Franklin Institute. This theory, Prof. B. further remarked, was entirely in accordance with observations which he had made upon the track of a storm, popularly called a *tornado*, which passed over a portion of the State of New Jersey, in June, 1835. He had surveyed, by compass, different parts of this track, and found the objects thrown down by the storm directed towards a center. He had found no evidence of a whirling motion at the surface of the ground.

Sir J. F. W. Herschel, (the President of the Section,) having resigned the chair to Mr. Baily, addressed the audience, and hailed this communication of Col. Reid, as one of happy omen for the progress of science in this important branch; and congratulated the meeting that the subject had fallen into the hands of those who had already made such progress in its elucidation, and from whom it was likely to receive so complete a sifting. He did not rise at present to add any thing to the stock of information already given, but, as having received from Mr. Redfield his papers on this subject, he could not neglect the opportunity of publicly expressing his thanks, and of stating the great pleasure he had derived from their perusal. And here he found an anecdote of Franklin frequently pressed on his recollection. A blunt seafaring man had demanded from Franklin, or in his presence, what had been done for the advantage or security of sailors by any landsman. At least, replied Franklin, you must admit that a landsman had discovered the most useful *art of navigation.* It was not only at sea that the practical value of this splendid discovery respecting hurricanes would develop itself in enabling the sailor to escape its violence, instead of running ignorantly into the very jaws of destruction, by attempting to run away; but even on land, it would suggest invaluable hints for the securing of life and property. One or two circumstances connected with Col. Reid's charts, particularly impressed him: the first was the curious parabolic shape of the courses denoting the progress of these storms, so well calculated to give unfailing directions as to the nature and course of a storm, when accidentally encountered at sea; as the sailor had only to consider the parts of these curves in which he was placed, and the veering of the wind, and he had almost placed before him a chart of the hurricane. He next threw out the suggestion for Col. Reid's consideration, whether the Gulf-Stream would not perhaps give a clue to the direction of these curves, as so large a body of comparatively warm water must most materially tend to heat the air above it, and thus occasion disturbances of atmospheric equilibrium. Col. Reid had stated that he had no theory: in this no doubt he was judicious as an observer; but yet, in the present assembly, a theory, if it served no better purpose, helped memory, suggested views, and was even useful by affording matter for controversy, which might produce brilliant results, by the very collision of intellect. In the second place, he remarked, that in the southern hemisphere, the oscillations of the barometer, which were in an opposite direction to those of the northern, afforded a strong confirmation of the correctness of Col. Reid's views. These revolving hurricanes reminded him, that on discharging a great gun unshotted, the mouth of which had been previously greased, a beautiful ring of smoke is formed, which passes to a considerable distance with much permanence, but constantly enlarging in diameter: upon attending closely to this, every part of the ring will be found to be in rapid revolving motion, thus exhibiting to the eye a hurricane in miniature, performing its evolutions. As to Mr. Espy's theory, though he considered it ingenious, yet he did not see how it was tenable against the indications of the barometer; for, unquestionably, if a large body of air were to set on every side inwards, towards a central ascending column, the necessary effect would be an increase of weight of the entire barometric column: but there was even stronger evidence against it; for if the air acquired any thing of a gyratory motion, on the principle of the *vis viva*, the rapidity of gyrations should increase enormously as we approach the center of the column; just as we see the opera dancers, in the pirouette, increase the rapidity of the evolution as they diminish the circuit; and so we find in the indications of the facts detailed by Col. Reid, regarding the hurricane,—as the circles of its gyrations open and extend, the storm is progressing towards spending its fury, and disappearing. Although it did not bear directly on the question now under discussion, yet he could not help saying, that there are circumstances connected with the *spots on the sun*, which forcibly impressed his mind with the idea of *tornadoes in the solar atmosphere*, which, by scattering and opening out the luminous superficial matters, laid bare the opake and dark mass beneath. It had at all times been a question with astronomers, how the spots were formed, supposing the luminous matter of the sun to be a merely superficial and uniformly spread stratum; but something like violent hurricanes being supposed to take place in the solar atmosphere, the difficulty is much diminished, if it did not entirely disappear; and in truth the appearance of the spots within the last year or two, was such as farther to induce the supposition of something in the solar atmosphere very like our trade-winds, for whereas, most usually, the spots have been scattered not very regularly over each hemisphere, they have latterly appeared more in lines following each other in succession, and having apparently an inclination towards the sun's equator on each side. If decided indications of any thing like trade-winds should, by this or other circumstances connected with the spots, be detected, the other conclusions would be much strengthened.

*Herschel's Astronomical Observations at the Cape of Good Hope.* These were reported under the following heads. 1. *Reduced Observations of* 1232 *Nebulæ and clusters of Stars, made in the years* 1834, 5, 6, 7, 8, *at the Cape of Good Hope with the* 20-*feet Reflector.* 2. *Reduced Observations of* 1192 *Double Stars of the Southern Hemisphere, made as above.* The observations in these two papers form parts of two catalogues of southern nebulæ and double stars respectively, which comprise the chief results of his astronomical observations at the Cape. They are complete only as far as the first nine hours of R. A. In the other hours, only a few of the objects which occur are added, being the results of a partial and very incomplete reduction of the observations in those hours. Sir J. thought that when all the observations are reduced for the catalogues, the number of objects contained in them will be nearly doubled. The *first* catalogue contains all the numerous nebulæ and clusters comprised in the two Magellanic clouds. Each reduced observation expresses the mean R. A. and North Polar distance of the object for the beginning of 1830, together with a description, in abbreviated language, of its appearance and physical peculiarities, as to size, brightness, condensation, &c. The observations of double stars in the *second* catalogue, express the mean place for the epoch above named,—the angle of position of the stars with the meridian, as micrometrically measured at the time of observation,—the estimated distance, and the magnitude assigned to each star, with a column of remarks, in which are noted peculiarities of color, &c. 3. *Micrometrical Measures of* 407 *principal Double Stars of the Southern Hemisphere, made at the Cape of Good Hope. with a 7-feet Achromatic Equatorial Telescope.* These measures were taken with the same achromatic and micrometer, and are arranged in precisely the same manner as the former similar observations made by Sir J., and printed in the Trans. of Royal Astron. Society. Among the principal double stars in this paper occur, α Centauri, α Crucis, γ Centauri, γ Lupi, μ Lupi, π Lupi, β Hydræ, ε Chameleontis, γ Piscis volantis, γ Coronæ Australis, &c. These measures afford unequivocal evidence of rotation in some of these double stars, particularly in α Centauri, β Hydræ, γ Coronæ, and π Lupi. In α Centauri, the decrease of distance, even within the short period of observation, is remarkable; and Sir J. remarked, that on examining the catalogues of the Astron. Soc., and that of Capt. Johnston, and the Paramatta Catalogue, in all which, the places of the two stars are given separately, he finds this diminution of distance fully borne out and regularly progressive; from which he concludes that in 15 or 20 years from this time, the stars may be expected to appear in contact, or to be actually occulted one by the other, as has recently been observed to happen to γ Virginis. 4. *A list of the Approximate Places of* 15 *Planetary and Annular Nebulæ of the Southern Hemisphere, discovered with the 20-feet Reflector; with Drawings illustrative of the Appearance and structure of* 3 *principal Nebulæ in the Southern Hemisphere.* These are arranged in order of R. A. and numbered. Among these, several are somewhat elongated, and offer the appearance of being double. No. 7 is of a fine blue color, and being particularly well-defined, has exactly the aspect of a blue planet. No. 4 is a very bright and considerably large elliptic disc of uniform light, on which, but excentric, is placed a pretty large star. Several are very small; No. 15 is not more than 3″

or 4″ in diameter. Many of them occur in crowded parts of the milky way, with not fewer than 80 or 100 stars in the field of view at once. The drawings are copies of much more elaborate originals, and merely selected from a greater collection, illustrating three of the most singularly constituted nebulæ in the S. Hemisphere, viz. θ Orionis, η Argûs and 30 Doradûs. Sir J. explained how, by means of a small achromatic collimator placed inside his great sweeping telescope, he was able to obtain nearly the same precision as was to be had in fixed observations; although from the ropes and wooden frame with which it was mounted, it was subjected to great hygrometric and pyrometric changes of form and position. These changes, by affecting alike the cross of the collimator, and the object, were readily detected and corrected.—Dr. *Robinson*, spoke in praise of the accuracy of the positions given in Sir J. Herschel's catalogues; and in favor of the application of reflecting telescopes to divided instruments. Notwithstanding the great increase in late years, of the size of achromatics, it seemed improbable that they would ever reach a magnitude which could not be easily overmatched by reflection. Something to this effect had been done in Ireland. In his own observatory was a reflector of 15 inches aperture, applied to an equatorial of cast iron, which gave polar distances with a probable error of about 6 seconds, and right ascensions to the ultimate reading of the hour circle verniers. The artist who executed this, had since made a reflecting transit of six inches aperture, which performed well, and its collimator was not affected by reversion. Sir J. Herschel remarked that the only change in a nebula, which he had yet noticed, was in that of Orion. A small transverse strip, which, when he first figured that nebula, was straight, had become curved, and showed a knotty appearance, which certainly it did not possess before.

*Remarkable Phenomena of Halley's Comet.*—Sir J. Herschel related the following. One of the most interesting series of observations, I had to make at the Cape of Good Hope, was that of Halley's Comet. This comet is the great glory of modern calculation. To see the predicted return of such a body now verified for the second time, true to a single day,—nay, to a few hours—of his appointed time, after an absence of 75 or 76 years, during which it has been subjected to the unceasing perturbations of all the planets, and especially persecuted by Jupiter and Saturn, those great stumbling-blocks of comets, is really superb. However, what I have now to relate, refers to a very singular and instructive fact in its physical history. I saw the comet for the first time after its perihelion passage, on the night of January 25. Mr. Maclear saw it on the 24th. From this time we of course observed it regularly. Its appearance at first, was that of a round, well-defined disc, having near its center, a very small bright object exactly like a small comet, and surrounded by a faint nebula. This nebula, in two or three more nights, was absorbed into the disc, and disappeared entirely. Meanwhile the disc itself dilated with extraordinary rapidity, and by measuring its diameter at every favorable opportunity, and laying down the measures by a projected curve, I found the curve to be very nearly a straight line, indicating a uniform rate of increase; and by tracing back this line to its intersection with its axis, I was led, at the time, to this very singular conclusion,—viz. that on the 21st of January, at 2 h. P. M. the disc must have been a point,—or ought to have no magnitude at all! In other words, at that precise epoch some very remarkable change in the physical condition of the comet, must have commenced. Well! all this was speculation. But here comes the matter of fact I refer to, and which, observe, was communicated to me no longer ago than last month by the venerable Olbers, whom I visited in my passage through Bremen, and who was so good as to show me a letter he had just received from M. Boguslawski, Professor of Astronomy at Breslau, in which he states, that he had actually procured an observation of that comet on the night of the 21st of January. Well then, how *did* it appear?—why, as a star of the sixth magnitude,—a bright concentrated point, which showed no disc, with a magnifying power of 140! And that it actually *was* the comet, and no star, he satisfied himself, by turning his telescope on that point where he had seen it. It was gone! Moreover, he had taken care to secure, by actual observation, the place of the star he observed; that place agreed to exact precision with his computation; in short, *that star was the comet.* Now, I think this observation every way remarkable. First, it is remarkable for the fact, that M. Boguslawski was *able* to observe it at all on the 21st. This could not have been done, had he not been able to direct his telescope point-blank on the spot, by calculation, since it would have been impossible in any other way to have known it from a star. And, in fact, it was this very thing which caused Maclear and myself to miss procuring earlier observations. I am sure that I must often have swept, with a night-glass, over the very spot where it stood in the mornings before sunrise. And never was astonishment greater than mine, at seeing it riding high in the sky, broadly visible to the naked eye, when pointed out to me by Mr. Maclear, who saw it with no less amazement on the 24th. The next remarkable feature, is the enormously rapid rate of dilatation of the disc, and the absorption into it of all trace of the surrounding nebula. Another, is the interior cometic nucleus. All these phenomena, while they contradict every other hypothesis that has ever been advanced, so far as I can see, are quite in accordance with a theory on the subject, which I suggested on the occasion of some observations on Biela's comet,—a theory which sets out from the analogy of the precipitation of mists and dews from a state of transparent vapor on the abstraction of heat. It appears to me, that the nucleus and grosser parts of the comet, must have been entirely evaporated during its perihelion, and re-precipitated during its recess from the sun, as it came into a colder region; and that the first moment of this precipitation was precisely that I have pointed out as the limit of the existence of the disc,—viz. on the 21st of January, 1836, at 2 P. M., or perhaps an hour or two later.

Rev. W. Whewell's *Account of a Level line measured from the Bristol Channel to the English Channel, during the years 1837–8, by Mr. Bunt, under the direction of a Committee of the British Association*, was read, the result of which is, that in July, 1838, the sea level at Portishead, (near Bristol,) was found to be ten inches higher than that at Axmouth; according to which, the mean level at Wick Rocks is 3.8 inches higher than at Portishead.

Prof. A. D. Bache, of Philadelphia, then communicated a "*Note on the effect of Deflected Currents of Air on the quantity of Rain collected by a Rain-gauge,*" the more remarkable phenomena noticed in it being represented by diagrams. Prof. Phillips's first Report on the quantity of rain collected at different heights, induced Prof. B. to begin a series of observations near the end of 1833. Philadelphia, from the extent of the plain on which it stands, was thought a good locality for this purpose. At first, gauges were placed at three different heights. One station was the top of a shot-tower 162 feet high; another was near the ground within the enclosure about the tower; and the intermediate one was the roof of the University. His attention was however ultimately fixed upon the fact that the effect of eddy winds upon the observed phenomena, was by no means a secondary one in amount, and that no law could be deduced, until this disturbing action was prevented. Prof. B. proceeded to make experiments on the effects upon the rain-gauges of the currents of air deflected by the tower, placing gauges at each angle. The results are given in a table, from which it appears that—1. The quantities of rain collected at the different angles of the tower were very different. In one extreme case the quantity collected at the S. E. angle was 2½ times that at the N. W. angle. 2. In general, the gauges to leeward received more rain than those to windward. Prof. Stevelly considered the fact that less rain was caught in elevated gauges than in those near the earth, to be due to the greater perpendicularity with which the rain falls near the ground, and not to a continued enlargement of the drops, during their descent, by new accessions of condensed moisture.

Dr. Daubeny read a paper on *the Climate of North America.* He began by observing, that although the general fact was admitted that the E. portions of the New World had a lower temperature than the W. portions of the Old, yet much remains to be done before the relative climate of these two portions of the globe can be regarded as in any degree determined. Most of the North American observations were not sufficiently accurate. In Canada, Mr. McCord's observations at Montreal were the best; and in the U. S., those made in N. Y., and published by the Regents of the University of that State. These results are however defective, in not giving the intensity of solar radiation, which probably affects the distribution of plants and animals in a manner quite distinct from its accompanying temperature. Hence, though many plants which grow in this country are killed by the winters of comparatively southern latitudes in America; yet others, which require the warmth of a wall or of a southern aspect here, are found in comparatively high latitudes in the New World. Sir D. Brewster called attention to the important fact, clearly established by the observations recorded in the neighborhood of New York, and those of Hansteen and Erman in Siberia, that two points of maximum cold existed in these regions, very generally agreeing in position with the centers of maximum magnetic intensities; and like them, too, the maximum of North America indicated a decidedly higher degree of cold than that which characterized the Siberian pole. Also, that the lines of equal mean temperature, as they surrounded these poles, had such a relation to the lines of equal magnetic intensity, as to point out clearly some yet unknown connexion between these two classes of phenomena. Prof. Bache, of Philadelphia, made some remarks on the importance of connecting the observations making in the U. S. with any which the Association might institute in the British Colonies in North America. Considerable progress had, within a few years, been made in America in the science of Meteorology. The abstracts of the reports of Meteorological observations from the academies of the State of New York, and the deductions made from them by Sir D. Brewster, had been a great stimulus to increased activity in that department. The recommendations of Sir John Herschel, had not only been adopted by individuals, but had led to the formation of societies for the cultivation of meteorology. He hazarded nothing in promising the hearty concurrence of meteorologists in the United States in any extensive plan which the British Association should sanction.

A paper from Prof. Powell followed, *On some points connected with the Theory of Light.*

Mr. Dent then read a paper *On the Construction of a portable Mercurial Pendulum, accompanied by Experiments.* The cistern is made entirely of cast-iron: the adoption of which metal permitted the cistern to be turned perfectly cylindrical within and without, and of thus simplifying the elements of calculation for the height of a perfect cylinder of mercury requisite for compensating the effects of variable temperature on the rod, an advantage, which glass did not allow. The homogeneity of the material also facilitates the reductions for temperature, by equalizing this throughout, and also permits the bearings to be diminished in number, and simplified in construction, when compared with the usual mercurial pendulum having glass cisterns. The suspending rod passes through a hollow screw, and is secured by a pin going through both. The hollow screw passes through the axis of the cistern, and the cistern is constructed to move round this screw, which admits of shortening or lengthening the pendulum for alteration in time. The edge of the cap belonging to the cistern is graduated, which subdivides the threads of the screw on the cistern, it being turned round for alteration in time. There is an aperture on the top of the jar, which allows of mercury being added or removed without unscrewing the cap of the cistern. This aperture is closed by a screw, which, as well as that on the cap, has a leathern collar to render the joints perfectly air-tight.'

Prof. Whewell made a "*Report on the Discussions of Tides,* performed under his direction, by means of the grant of money made for the purpose by the Association." Prof. W. remarked, that he had adopted the method of curves, first systematically employed by Sir J. Herschel, which consists in laying down a number of points expressing the results of individual observations, and then getting rid of the irregularities which these involve, by drawing, not a line *joining* the points, which would be a broken line, but by striking with a bold but firm hand, a line *among* the points, so as to come as near as possible to the whole assemblage of them. In this manner the heights and lunitidal intervals were laid down as ordinates, and curves were drawn. This method of curves depends upon the fact, that the eye generalizes the relations of space more rapidly and surely than the intellect can generalize phenomena in any other way.

Mr. Russell, of Edinburgh, brought up the "*Report of the Committee* (consisting of Sir John Robison and himself) *on Waves.*" This report was a continuation of that of last year, recently published. These researches are of great value and interest, but it is scarcely possible to condense the account. We give merely some remarks on the best forms for ships. One part of his subject was the relation which the translation-wave bore to the phenomena of resistance of fluids. He had previously ascertained that the displacement of a fluid by a vessel took place, not in the body of the current, but solely by the generation of waves. Now, the manner in which they were generated appeared to throw light upon the subject of the resistance of fluids; because they wished to have exactly the same transference for particles of matter which was required for transference of waves. They wished to remove the particles of fluid from a state of rest, and admit the vessel to pass through, and then allow them to return to their former places, just as in the wave the particles were first elevated above the surface, and then permitted to subside. Now they found that whenever the displacement took place, as in the wave, they had the phenomena of least resistance. So that in forming a floating vessel with this wave-line disposed on alternate sides of the keel, so as to give such motion to the particles as to displace nothing more than was necessary, nor for a greater distance than was necessary to allow the vessel to pass, they obtained the solid of least resistance. Since that time, a variety of experiments on large vessels had been performed; steam-vessels were now constructing on this form; and it was a remarkable fact, that the fastest vessel on the Thames was one to which this form had been given. It was scarcely credible, that a vessel should move at the rate of fifteen miles an hour, and not raise a spray,—not raise anything like that high mass of water which was always found at the bows of vessels going at speed, but enter the water perfectly smooth, and leave it smooth, and as much at rest in the direction of the displacement as it was before the floating solid passed. This phenomenon had invariably accompanied all the vessels formed on this line.

*On some Preparations of the Eye*, by Dr. W. Clay Wallace. Sir D. Brewster exhibited a series of beautiful preparations of the eye, made by Dr. W. Clay Wallace, an able oculist in New York, calculated to establish some important points in the theory of vision. As no paper accompanied these preparations, Sir D. Brewster explained to the meeting their general nature and importance. Dr. Wallace, he stated, considers that he has discovered the apparatus by which the eye is adjusted to different distances. This adjustment is, he conceives, effected in two ways,—in eyes, which have *spherical lenses*, it is produced by a *falciform*, or hook-shaped muscle attached only to one side of the lens, which by its construction brings the crystalline lens nearer the retina. In this case, it is obvious that the lens will have a slight motion of rotation, and that the diameter, which was in the axis of vision previous to the contraction of the muscle, will be moved out of that axis after the adjustment, so that at different distances of the lens from the retina, different diameters of it will be placed in the axis of vision. As the diameters of a sphere are all equal and similar, Dr. Wallace considered that vision would be equally perfect along the different diameters of the lens, brought by rotation into the axis of vision. Sir D. however, remarked, that he had never found among his numerous examinations of the lenses of fishes, any which are perfectly spherical, as they were all either *oblate* or *prolate* spheroids, so that along the different diameters of the solid lens, the vision would not be similarly performed. But, independent of this circumstance, he stated that in every solid lens there was only one line or axis in which vision could be perfectly distinct, namely, the axis of the optical figure, or series of *positive* and *negative* luminous sectors, which are seen by the analysis of polarized light. Along every other diameter, the optical action of the lens is not symmetrical. When the lens is not *spherical* but *lenticular*, as in the human eye and in the eyes of most quadrupeds, Dr. W. considers that the apparatus for adjustment is the ciliary processes, to which this office had been previously ascribed, though not on the same scientific grounds as those by him discovered. One of the most important results of Dr. W.'s dissections, is the discovery of *fibres in the retina.* These fibres may be rendered distinctly visible. They diverge from the base of the optic nerve, and surround the *foramen ovale* of Sömmering at the extremity of the eye. Sir J. Herschel had supposed such fibres to be requisite in the explanation of the theory of vision, and it is therefore doubly interesting to find that they have been actually discovered. Sir D. concluded by expressing a hope that British anatomists would turn their attention to this subject.

Sir D. Brewster then communicated his researches on "*A New Kind of Polarity in Homogeneous Light.*" At the last meeting, said he, I gave an account of a *new property of light*, which did not admit of any explanation. Since that time, I have had occasion to repeat and vary the experiments; and having found the same property exhibited in a series of analogous though different phenomena, I have no hesitation in considering this property of light as indicating *a new species of polarity* in the simple elements of light, whether polarized or unpolarized. After detailing the experiments, he says, hence I conclude that the different sides of the rays of homogeneous light have different properties when they are separated by prismatic refraction or by the diffraction of grooved surfaces or gratings;—that is, *these rays have polarity.* When light is rendered as homogeneous as possible by absorption, or when it is emitted in the most homogeneous state by certain colored flames, it exhibits none of the indications of polarity above mentioned. The reason of this is, that the more or less refrangible sides of the rays lie in every direction, but as soon as these sides are arranged in the same direction by prismatic refraction or by diffraction, the light displays the same properties as if it had originally formed part of a spectrum. Some discussion among the members, on points connected with this subject, ensued.

Sir Wm. R. Hamilton then made a communication respecting the *propagation of light in vacuo;* and subsequently, on the *propagation of light in crystals.* The object of these papers was to advance the state of our knowledge respecting the law which regulates the attractions or repulsions of the particles of the ether on each other.

Sir J. Herschel offered a *Note on the Structure of the Vitreous Humor of the Eye of a Shark.* The result is, that the vitreous humor, (so called,) of this fish is no jelly, but simply a clear liquid, inclosed in some close cellular structure of transparent membranous bags, which, by their obstruction to the free movements of the contained liquid, imitate the gelatinous state.

Mr. Ball, of C. C. Cambridge, read a paper "*On the meaning of the Arithmetical Symbols for Zero and Unity, when used in General Symbolical Algebra.*"

A communication was read from Prof. Forbes, "*On Subterranean Temperature; and notice of a Brine Spring emitting Carbonic Acid Gas.*" Observations had been made and were now in progress, on the temperature of the earth at various distances beneath the surface, in the vicinity of Edinburgh, the results of which he intended to lay before the next meeting of the Association. The *brine spring* is about a mile from Kissingen, Bavaria. It has 3 per cent of salt, and rises in a bore 325 Bavarian feet deep in red sandstone; but it is understood that the water flows at about 200 feet in depth. Its temperature is never less than 65°,—the mean temperature of springs near, being only 50° to 52°. It discharges carbonic acid gas in volumes almost unexampled, keeping the water,—in a shaft of eight feet diameter,—in a state resembling turbulent ebullition. The enormous supply of gas has led to its use in gas baths, for which purpose it is carried off by a tube connected with a huge inverted funnel, which rests upon the water. It contains scarcely a trace of nitrogen. It is conducted into chambers properly prepared and thence into baths, in which it lies by its weight, and is used as water would be. But the most remarkable feature still remains. About five or six times a day the discharge of gas suddenly stops; in a few seconds the surface of the well is calm. The flow of water, amounting to 40 *cubic feet per minute,* also stops, or rather, becomes *negative,* for the water recedes in the shaft even when the pumps, commonly used to extract the brine, do not work, and the water subsides during 15 or 20 minutes. It then flows again, the water appearing first and suddenly, the gas gradually increasing in quantity, till, after three quarters of an hour, the shaft is full as at first. The state of greatest discharge continues with little variation since the bore was made in 1822. Within a short distance is a bore 554 Bavarian feet deep, which exhibits somewhat similar phenomena. Altogether, Prof. F. considers that the salt spring at Kissingen is the most singular phenomenon of its kind in Europe except the Geysers.

Mr. Russell gave a description of a "*Substitute for the Mountain Barometer in Measuring Heights,*" by Sir John Robison. Mr. R. said, that all persons who had used the mountain barometer, when measuring heights, would admit that it was a very cumbersome instrument, put out of order by very slight accidents, and only to be used by persons well skilled in observing. The principle of Sir J. Robison's contrivance is simple, and such that the most ignorant person might be intrusted with the preparatory manipulation of it, and might be sent up mountains when the philosopher could not leave his study, and bring back the air to be experimented upon; and, since he could not go to the air with his barometer, to cause it to come to him. It consisted of a wooden box, containing simply a thermometer and a number of tubes, of a bore something wider than those of self-registering thermometers, open at one end, and blown into bulbs at the other; also a small vessel of quicksilver. All that the person who went up the mountain had to do, was to note the thermometer, and immerse the open end of one of the tubes into the mercury at each station, and then bring down the whole. The examiner then places each bulbed tube, into the stem of which a considerable quantity of mercury will, of course, be found to have entered, under the receiver of an air pump, either along with a barometer, or with a well-made gauge: and on pushing the exhaustion until the mercury stood within the bulbed tube as it did upon the mountain, making certain simple allowances for temperature, the height at which the barometer would have stood at the station on the hill can be deduced; and thence, by the usual calculation, the height of the station. The stem of the instrument is previously graduated, so that bare inspection shows the density of the air at the elevated station.

Sir D. Brewster communicated the following papers: "On a new phenomenon of Color in certain specimens of Fluor-Spar."—"On an Ocular Parallax in Vision, and on the law of visible direction."—"An account of certain new phenomena of Diffraction."—"An account of an analogous series of new phenomena of Diffraction when produced by a transparent diffracting body."—"On the combined action of grooved metallic and transparent surfaces upon Light." These valuable papers called forth from Sir J. Herschel the highest praise. "There is extreme difficulty," said he, "in following with sufficient rapidity for discussion, such an absolute torrent of new matter. Indeed, the discoveries of Sir D. Brewster, whether viewed in relation to the intervals at which they succeed each other, or the instruction they convey, equally fill us with delight and astonishment."

A paper *on the Helm Wind of Crossfell,* was read by Rev. J. Watson.

Dr. Smith read a paper *on the Variations in the quantity of Rain which falls in different parts of the Earth.* The causes of these variations are, the author imagines, to be ascribed to the physical differences of the vicinity of each place, and in the track of the most rainy winds; and he found this opinion confirmed by a long average of Westerly and Easterly winds at London, compared with six other places.

Prof. Wheatstone read a paper *on Binocular Vision, and on the Stereoscope, an instrument for illustrating its phenomena.* The instrument is so named, from its property of presenting to the mind the perfect resemblances of solid objects. A short explanation of the principles of the instrument was offered by Prof. W. Sir D. Brewster feared that the members could scarcely judge from the very brief and modest account given by Prof. W. of the principle and of the instrument devised for illustrating it, of its extreme beauty and generality. He considered it one of the most valuable optical papers which had been presented to the Section. He observed, that when taken in conjunction with the law of visible direction in monocular vision, it explains all those phenomena of vision by which philosophers had been so long perplexed; and that vision in three dimensions received the most complete explanation from Prof. W.'s researches. Sir J. Herschel characterized Prof. W.'s discovery as one of the most curious and beautiful for its simplicity, in the entire range of experimental optics.

Rev. Charles Graves read a paper on a *General Geometric Method.*

Sir T. M. Brisbane reported the result of an experiment to determine the difference of longitude between London and Edinburgh. Having observed the surprising accuracy with which the difference of longitude of London and Paris had been obtained by Mr. Dent's chronometers, he applied to him, and he very liberally placed at his disposal twelve of his valuable chronometers. With these, the differences of longitude of London, Edinburgh and Makerstoun, were taken; and by a mean of all the observations taken in going to the latter station and in returning, they were found to differ only by five one-hundredths of a second.

A letter from the Astronomer Royal, G. B. Airy, was read, on *the means of correcting the local magnetic action of the Compass in iron Steam-Ships.* By an apparatus of his invention, the local deviations were almost wholly corrected. The description will probably be given hereafter.

Prof. Lloyd read a paper entitled, "*Recalculation of the observations of the Magnetic Dip and Intensity in Ireland, with additional elements.*" It is found that the annual decrease of the dip at Dublin is 2′.38. The recent and more complete observations of Sabine at London, make the annual decrease there 2′.40. Major Sabine spoke in reference to the *Report on the Variations in the Magnetic Intensity,* printed in the last volume. He adverted to the observations of Profs. Bache and Courtenay, made in New York and the adjoining States, and which Prof. B. is now engaged in connecting with Europe. Until this comparison is complete, these observations determine the value of the magnetic force at the stations at which they are made, relatively to each other, but not relatively to other parts of the globe. It was for this reason that they were not available for Sabine's Report, which had for its object the general distribution of the magnetic force over the earth's surface. The American observations were made with needles inclosed in a vacuum apparatus, which Prof. B. had devised, with the view of avoiding some of the anomalies occasionally experienced by other observers. They were made with extreme care, and were remarkable for minute attention to all those circumstances which conduce to the accuracy of the results.

The secretary read Mr. Snow Harris's *Report of Meteorological Observations made at Plymouth.* Mr. E. Hodgkinson gave several observations made the last year *on temperature in deep mines* in Cheshire and Lancashire, a full report of which he hoped to offer at the next meeting. Mr. Russell described an apparatus for showing the *connexion of magnetism with the wind*, invented by Mr. Watt.

### Section B. *Chemistry and Mineralogy.*

Dr. Thomas Thomson *on Native Diarseniate of Lead.* During the meeting of the Association at Liverpool, a collection of minerals from Alston Moor was exposed for sale. Among them was one labelled, "Vanadiate of lead from Caldbeck Fell." It was in botryoidal concretions on quartz. Several of these nodules, had, under the microscope, the aspect of cylinders. *Color*, honey-yellow, like that of arseniate of lead, but lighter and much less translucent. *Lustre*, resinous, and more brilliant than that of vanadiate of lead. Does not scratch calcareous spar, but scratches gypsum with great ease. *Gravity*, 7.272; that of vanadiate of lead is only 6.663. Before the blowpipe on platinum foil, it melts into a transparent globule, which on cooling, assumes nearly its original appearance. On charcoal, it gives out abundant arsenical fumes, and leaves globules of metallic lead. Two analyses by Mr. Stenhouse gave,

| | |
|---|---|
| Chlorine, - - - - - - - | 2.46 |
| Lead, - - - - - - - - | 7.10 |
| Arsenic acid, - - - - - - | 18.20 |
| Protoxide of lead, - - - - - - | 70.14 |
| Peroxide of iron, - - - - - - | 1.20 |
| Volatile matter, - - - - - - | 1.00 |
| | 100.10 |

Mr. Scanlan communicated observations on the *Constitution of the Commercial Carbonate of Ammonia.* The results of his investigations are, that this substance is not a homogeneous salt, a true sesquicarbonate, as Mr. Phillips considered it, but a mechanical mixture of carbonate and bicarbonate. Mr. S. also read a paper on *the blackening of Nitrate of Silver by Light.* Experiments which he has made result in the conclusion previously asserted by Dr. J. Davy and by Mr. Fergusson, (although contradictory to the statements of most books of chemistry,) that pure nitrate of silver, is not blackened by continued exposure to sunlight, unless organic matter is present.

Mr. Thomas Richardson presented an examination of two specimens of *Sphene,* one from Arendahl in Norway, and the other from an unknown locality.

Mr. Thomas Exley read a paper on the *specific gravities of Nitrogen, Oxygen and Chlorine, and of the Vapors of Carbon, Sulphur, Arsenic and Phosphorus.* By experiment and calculation, he finds the following to be the true gravities of these substances, viz. N. = .9722, O. = 1.1111, H. = .0694, Chl. = 2.5, C. = .8333, S. = 2.2222, Ars. = 5.2777, Ph. = 2.2222. Mr. E. concluded by suggesting an opinion that there is another elementary body, yet undiscovered, having both an exceedingly small sphere of repulsion, and an exceedingly small atomic weight, or absolute force. This substance, he conceives, gives rise to the miasmata of marshes, to infectious effluvia and other concomitant exhalations; chlorine, acids and other substances, owe their disinfecting qualities to their power of absorbing this substance into their atmospheres. If its existence should be ascertained, *Microgen* might be deemed an appropriate name.

Dr. T. Thomson read a paper on *Diabetic Sugar.* This sugar has been commonly considered as isomeric with starch sugar. *Taste,* sweet; *color,* snow-white; *gravity,* after fusion 1.56 at 65°: melts at 239°; 100 parts of water dissolve 108 parts of it. Boiling water dissolves any quantity. Soluble in alcohol. It crystallizes, but so irregularly that the shape of the crystals has not been ascertained. After being dried in vacuo over sulphuric acid, it loses an additional atom of water if it be exposed to a heat of 212°, without losing weight. Analysis of it gave,

| | | | | |
|---|---|---|---|---|
| Carbon, | 37.23, | or 12 atoms | = 9. | = 38.09 |
| Hydrogen, | 7.07, | or 13 " | = 1.625 | = 6.88 |
| Oxygen, | 55.70, | or 13 " | = 13. | = 55.03 |
| | 100.00 | | 23.625 | 100.00 |

By Dr. Prout's analysis, starch sugar is $C^{12}H^{14}O^{14}$, or it contains an atom of water more than diabetic sugar.

Mr. Robert Mallet read a communication on *a new case of the decoloration of recent solutions of Caustic Potassa of commerce, and on the nature of the coloring matter.* The author stated, that the caustic potassa of commerce, was well known to be a very impure compound, containing besides potassa, sulphate of potassa, chlorides of potassium and iron, peroxide and carbonate of iron, silex, charcoal, and generally lime. He had also in one case found a trace of cobalt, and in several protoxide of lead, probably from the vessels used in its preparation. The color of recent solutions of this potassa in water freed from air by boiling, is apple-green, and occasionally, purplish-green, which, whether exposed to air or not, or in dark or light, gradually disappears, leaving the solution colorless. A red precipitate of peroxide and carbonate of iron is produced on solution; but, after a time, the green solution in losing color, deposits a second in very small quantity, which Mr. M. has found, by analysis, to consist of,

| | |
|---|---|
| Sesquichloride of iron, - - - - | 15.7 |
| Sesquioxide of iron, - - - - | 83.2 |

The decoloration of the solutions of common caustic potassa was effected by violet-colored light in 30 hours, and by red in 200 hours.

Mr. H. Pattinson gave an account of a new process, by him discovered, for the *extraction of Silver from Lead.* By this process, the details of which are too extensive for insertion here, a large amount of both lead and silver wasted by the methods now employed, would be saved.

Dr. Golding Bird communicated "Observations on some of the *Products of the action of nitric acid on Alcohol.*" Numerous experiments are related in this paper, and the following are some of the author's conclusions. 1. During the action of nitric acid on alcohol, no oxalic acid is formed as long as nitrous ether alone distils over. 2. Aldehyd is not produced, in any appreciable quantity, until oxalic acid appears in the retort, and the production of nitrous ether nearly ceases. 3. During the preparation of nitrous ether in the cold, acetic acid is abundantly produced, and appears to replace the oxalhydric acid formed when heat is employed.

Dr. B. also communicated a paper "*On the possibility of obtaining by Voltaic action, crystalline metals,* intermediate between the Poles or Electrodes," and exhibited a mass of plaster of Paris (upon which he had operated) containing little veins of copper disseminated through it in every direction, which presented a marked resemblance to those met with on the large scale in nature.

Prof. Johnston described a *compound of sulphate of lime,* deposited from a high-pressure boiler, containing half an atom of water, and in this particular differing from any other composition of the kind.

Mr. Phillips stated that the *Blue Pigment* submitted last year by Dr. Traill, was Prussian blue largely diluted, and rendered pale by ferrocyanide of antimony.

Prof. Graham read a *Note on the Constitution of Salts.* He wished to draw attention to a distinction in saline combinations which is too often overlooked, and confusion thereby occasioned. The orders of monobasic, bibasic, and tribasic salts, of which the phosphates proved types, have lately been greatly enlarged by the discoveries of Liebig and Dumas respecting vegetable acids, and the distinctive characters of these orders are well understood. The best proof that an acid is bibasic or tribasic is its combining at once with two bases which are isomorphous, or belong to the same natural family,—as phosphoric acid does with soda and ammonia in microcosmic salt, and tartaric acid with potassa and soda in Rochelle salt. Water and magnesia, water and barytes, water and oxide of lead, are also constantly associated as bases in bibasic and tribasic salts, but never in true double salts, or combinations of two or more salts with each other, with which salts of the preceding orders are often confounded. But it is too generally supposed that a metallic oxide cannot exist in a saline combination, except in the capacity of base, although in most of those bodies which are at present termed *sub-salts,* the whole or a portion of the metallic oxide is certainly not basic, but is attached to a really neutral salt; in a capacity similar to that of constitutional water, or water of crystallization. The test of the non-basic character of water or a metallic oxide in a compound, is the absence of a parallel combination containing an oxide of the potash class.

A paper by Dr. Andrews, was read, on *the influence of Voltaic combination on Chemical action.* He endeavored to show that the proper tendency of a voltaic circle is to diminish the chemical action of the solution on the electro-positive metal, from the consideration, that in ordinary solution, the electricities thus developed have only an indefinitely small portion of liquid to traverse; while in voltaic solution their reunion can be effected, only by passing across a column of variable extent, and composed of an imperfectly conducting substance.

Mr. Robert Mallet read his report of the experiments instituted at the command and with the funds of the Association, "*On the action of Sea and River Water, whether clear or foul, and at various temperatures, upon Iron, both cast and wrought,*" and made by himself and Prof. E. Davy, of Dublin. The report is comprised under four principal sections, viz. 1. A brief summary of the actual state of our chemical knowedge of the reactions of air and water on iron. 2. A statement of the nature and extent of the experiments on the action of water on iron, which have been made on the great scale for the use of the engineer as well as chemist. 3. A refutation of the method proposed by J. B. Hartley, of preserving iron by brass. 4. A new method, founded on electro-chemical agencies, for the protection of wrought and cast iron; with a statement of various desiderata upon the subject.

A paper was presented, by Mr. Robert Addams, *On the construction of Apparatus for solidifying Carbonic Acid Gas in contact with the liquid form of the Acid, at different temperatures.* Mr. A. adverted to the original production of liquid carbonic acid by Dr. Faraday, in 1823, and also to the solidification of the acid by Mr. Thilorier, and then exhibited three kinds of instruments which he (Mr. A.) had employed for the reduction of the gas into the liquid and solid forms. The first mode was mechanical, in which powerful hydraulic pumps were used to force gas from one vessel into a second, by filling the first with water, saline solutions, oil or mercury; and in this apparatus a *gauge of observation* is attached, in order to see when the vessel is filled. The second kind of apparatus is a modification of that invented and used by Thilorier. The third includes the mechanical and the chemical methods, by which is saved much of the acid formed in the generator; whereas by the arrangement of Thilorier's plan, two parts in three rush into the atmosphere and are lost. With this set of instruments are used two gauges of observation,—one to show when the generator is filled with water by the pumps, and consequently all the free carbonic acid forced into the receiver; and the other to determine the quantity of liquid acid in the receiver. A table of the elastic force or tension of the gas, over the liquid carbonic acid was shown for each ten degrees of the thermometer, from 0° to 150°. The following are some of the results:

| Degrees. | lb. per square inch. | Atmospheres of 15 lbs. each. |
|---|---|---|
| 0 | 279.9 | 18.06 |
| 10 | 300 | 20 |
| 30 | 398.1 | 26.54 |
| 32 | 413.4 | 27.56 |
| 50 | 520.05 | 34.67 |
| 100 | 934.8 | 62.32 |
| 150 | 1495.65 | 99.71 |

Mr. A. intends to examine the pressure at higher temperatures, up to that of boiling water and above; and he asserted his belief that it may be profitably employed as an agent of motion,—a substitute for steam,—not directly, as had been already tried by Mr. Brunel,—but indirectly, and as a means to circulate or reciprocate other fluids. The solidification of the acid was shown, and the freezing of pounds of mercury in a few minutes, by the cooling influence which the solid acid exercises in passing again to the gaseous state.

Dr. T. Thomson communicated a paper on the *foreign substances contained in Iron.* These are carbon, manganese, silicon, and phosphorus in very minute quantities.

Prof. Johnston read a paper on some *exceptions to the law of Isomorphism,* showing that substances crystallizing in the same form were not always composed of the same formulæ.

Dr. R. D. Thomson and Mr. T. Richardson presented a communication on *the decomposition produced by the action of Emulsin on Amygdalin.*

A paper was offered by Mr. Exley, *on Chemical combinations produced in virtue of the presence of bodies which remain to continue the process.* It has been observed, said Mr. E., that in many instances, powerful chemical affinities have been brought into activity by the presence of certain bodies which remain insulated. This Berzelius attributes to a peculiar force, which he calls *catalytic* force. Several reasons are adduced to show that this force is but one species of the general effects which usually occur in chemical actions, all of which are modifications of universal gravity arising from circumstances.

Mr. William Herapath gave a paper on *a new process for tanning.* He assumed that the great cause of obstruction to rapid tanning, is, that the weakened ooze is retained by the capillary attraction of the fibres and blood-vessels so long, that when it shall have passed out by exosmosis, it will have produced the same effect upon the soluble gelatin as is produced by maceration. Hydraulic pressure was too expensive, and he accordingly thought of employing pressure by the roller.

*On the application of gas obtained by Water to the manufacture of Iron*, by Mr. J. S. Dawes. The mode is as follows. Jets of steam are made to pass through red hot cast-iron pipes, filled with small coke or charcoal; decomposition immediately takes place; the base of the carbon of the coke combines with the oxygen base of the steam, forming, at first, carbonic acid, but by passing this over a further portion of red hot carbon, it is converted into carbonic oxide, sensible heat at the same time becoming latent on combining with the hydrogen base, producing hydrogen gas, which, together with the oxide before mentioned, is applied to the furnace by means of a jet inserted within the blast-pipe tuyere, the pressure of the gas, of course, being equal to that upon the blast.

A description, by Prof. Miller, was next read, of an *improvement in the construction of the Reflective Goniometer, by which it is rendered more portable.*

Dr. T. Thomson gave an account of *Galactin*, a substance which constitutes the principal ingredient in the sap of the Cow tree, or *Galactodendron utile* of South America. The sap, on standing, throws up a white matter, soluble in boiling alcohol, but deposited as that liquid cools. When well washed and dried in vacuo, over sulphuric acid, it constitutes *galactin.* It is yellow, translucent, and brittle, has a resinous aspect and is tasteless. It is insoluble in water, but soluble in alcohol and ether. Gravity, 0.969. It dissolves readily in oil of turpentine and olive oil. It is composed of 6 atoms carbon, 4.5+6 atoms hydrogen, .75+1 atom oxygen, 1, = 6.25, being isomeric with Brazil wax.

The secretary, Prof. Miller, read a paper on Lieut. Morrison's instrument for measuring the electricity of the atmosphere, and also a paper by Mr. J. C. Blackwell on the formation of crystals of silver by the contact of brass with nitrate of silver.—Prof. Johnston read a paper on the *Resin of Gamboge and its salts.* He also produced some specimens of resinous substances found in coal mines, and expressed his belief that this resin was an exudation from the trees of which the coal is composed.—Dr. Bird stated that he had formed chloride of copper by the voltaic action.—Mr. Mangham read a paper on *a new Compound of Carbon and Hydrogen.* When the electrodes of a voltaic battery are armed with charcoal points, by means of platinum wires, and then brought under water, so as to produce the spark in the ordinary way, neither hydrogen nor oxygen gases are evolved, but carbonic oxide passes off, and a compound, not previously noticed, remains in the water, consisting of carbon and hydrogen.—A letter from Prof. Hare, of Philadelphia, was read, on his mode of *fusing large masses of Platinum.* Mr. Maugham claimed this as his own discovery.*

## Section C. *Geology and Geography.*

Mr. Long presented *a Description of a Bone Cavern in the Mendip Hills.* The cavern is on the summit of one of the Mendip Hills, in a limestone rock. It was discovered in pursuing a fox, which fled there for shelter. It is entered by a perpendicular fissure, 30 feet deep. From a large chamber at the bottom of this fissure an arched way leads into another chamber, from which a passage leads up towards the surface, and this latter seems to have been the original entrance. The bones are generally found imbedded in soft mud, in hollows in the bottom of the cavern, but sometimes also in stalactite. The greater part of the bones are those of the ox, horse, deer, fox, boar, &c. But the most interesting circumstance connected with this deposit is, the existence of human bones, which are found beneath the others. Nine skulls were also obtained. Many of the bones are in so decayed a state, that they crumbled to dust on being handled. It is worthy of remark that none of the bones belong to extinct species. Prof. Sedgwick observed, that no human bones had yet been found in any of the old caverns, unless under circumstances which clearly showed their recent introduction; and this cavern did not militate against the received theory of the formation of osseous breccias. It may have been a place of ancient sepulture, the bodies being let down through a stratum of clay and gravel.

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* See Dr. Hare's paper in the present No.—Eds.

The next communication was *on the Newcastle coal field*, by Mr. John Buddle. This coal field occupies a tract in the counties of Northumberland and Durham of about 700 square miles. Mr. B.'s very valuable essay was fully illustrated by a profusion of accurate and highly-finished drawings, plans and sections.

A paper was received from Prof. Von Baer, of St. Petersburgh, entitled "*Recent Intelligence respecting the frozen ground in Siberia.*" Additional experiments on the temperatures during the year at different depths have recently been commenced at Yakutsk, details of which we shall have hereafter.

Mr. Lyell, the President of the Section, read a paper *on vertical lines of Flint, traversing horizontal strata of Chalk, near Norwich.*

Mr. Webb read a short notice of *Lunar Volcanoes.* He had for some time examined the moon with an excellent five-feet achromatic, and had found that several volcanic vents existed not laid down in Schröter's lunar map; and also, that several vents, which had been so laid down, were now much enlarged in dimensions. On the whole, however, he considered that the moon and the earth were similar in this respect, viz. that volcanic action was now less violent than it had been in by gone periods.

The secretary read *a brief account of a Mandingo, native of Nyáni-marú, on the River Gambia*, by Capt. Washington, R. N. This man, after many adventures, is now in England. As already observed by Goldberry and Laing, of the Mandingos generally, he resembles in his features the Hindoos more than the blacks of Africa in general. His features are regular and open, his person well-formed, full six feet in height, his nose Roman, with the nostrils rather flattened, not thick lips, beautiful teeth, hair woolly, color a good clear black, not jet. With the aid of Mr. Renouard, a vocabulary of about 2000 words and phrases in the Mandingo language had been gathered from this native, besides itineraries in various parts of his country; and when we consider how extensively spread is this language, perhaps the most so of any of the 36 families of languages into which authors have divided the 115 languages of Africa, and that hitherto a vocabulary of about 400 words is all that we possessed of it, it will be admitted that this native of Gambia has not been an unprofitable subject of geographical inquiry.

Next was read a *Sketch of the recent Russian Expeditions to Novaïa Semlïa*, by Prof. Von Baer.

Lieut. Col. Don J. Velasquez de Leon gave a short account of a map of Mexico recently made by order of the Government.

Capt. Washington, R. N. communicated an *account of the Recent Expeditions to the Antarctic seas.* This paper was illustrated by a South circumpolar chart on a large scale, showing the tracks of all former navigators to these seas, from Dirk Gherritz in 1599, to M. d'Urville in 1838; including those of Tasman in 1642, Cook in 1773, Bellingshausen in 1820, Weddell in 1822, Biscoe in 1831, and exhibiting a vast basin, nearly equal in extent to the Atlantic ocean, unexplored by any ship, British or foreign. The writer pointed out that the ice in these regions was far from stationary; that Bellingshausen had sailed through a large space within the parallel of 60°, where Biscoe found ice that he could not penetrate:—that where d'Urville had lately found barriers of field-ice, Weddell, in 1822, had advanced without difficulty to the lat. of 74¼°, or within 16° of the pole; and that it was evident from the accounts of all former navigators, that there was no physical obstacle to reaching a high southern latitude, or, at any rate, to examining those spots which theory pointed out as the positions where the southern magnetic poles will probably be found. The paper also mentioned the expedition to the South Seas, which has just left this country fitted out by several merchants, but chiefly under the direction of that spirited individual, Mr. Enderby, whose orders were to proceed in search of southern land, and to attain as high a south latitude as possible.

Mr. Murchison gave an account of a *Geological map and sections of the border counties of England and Wales.*

Mr. Griffith gave an account of his *Geological map of Ireland*, and of two remarkable sections in the south of that country.

A paper *on the stratification of rocks*, by Mr. Liethart, of Newcastle, was next read.

A short paper by Mr. Trimmer was read *on the occurrence of marine shells over the remains of Terrestrial Mammalia in Cefn Cave, in Denbighshire.* The cave is in carboniferous limestone;

the bones of the rhinoceros, hyena, &c. are contained in marl beds and stalactite; and over these the fragments of marine testacea, showing the irruption into this cave of a diluvial current.

Dr. Daubeny read a paper *on the Geology and Thermal Springs of North America.* The facts which he was about to detail, Dr. D. said he had become possessed of, partly from his own researches during a late visit, and partly through the kindness of the Messrs. Rogers, to whose labors in American geology he paid a just tribute of approbation. He then gave a short sketch of the different chains of mountains in the United States. He stated briefly, as the result of his examination of various *thermal springs* in the U. S., that they gush out in all instances along lines of fracture of the strata, a result similar to that which he had already established respecting the thermal waters of Europe. Dr. Buckland communicated the contents of a letter from Mr. Lea, stating that the quantity of coal in the valley of the Mississippi was vastly greater than has hitherto been supposed.

The next paper was *on the structure of Fossil Teeth,* by Mr. Owen. The internal organization of the teeth in the higher mammalia, as shown by magnified transverse sections, was first described. The curious modifications which this structure undergoes in the Megatherium, the Ichthyosaurus, and fossil fishes, were pointed out in detail, and illustrated by numerous magnified drawings. It is impossible here to give the details, but the general result of the investigations is a most important one to geologists, viz. that the different genera may be distinguished by the internal structure of their teeth alone; and therefore, when other characters fail, or a complete tooth is unattainable, generic, nay, perhaps even specific identity, may be established by merely obtaining a thin slice of one of these fossil teeth. Prof. O. read before the Medical Section, the day previous, a paper *on the structure of teeth and the resemblance of ivory to bone, as illustrated by microscopical examination of the teeth of man, and of various existing and extinct animals.* This paper contains the results of extensive investigations, conducted with Prof. O.'s usual skill and thoroughness, on the internal structure of the teeth of various orders of animals.

Dr. Buckland communicated *an Account of Footsteps on Sandstone near Liverpool.* This interesting discovery was made in a quarry on the summit of the peninsula between the Dee and Mersey, at a considerable depth from the surface, by two intelligent persons, Forrester and Horne, connected with the quarry, and an account of the circumstances was drawn up on the spot by Messrs. Cunningham and Dwyer. The specimens found were casts of the impression of the foot, and nothing could be more perfect and characteristic. There are two sets of footsteps; one set being those of an animal of which traces have been before observed, and which has been called *Cheirotherium*, from its hand-like foot: the other, those of smaller animals, which seem to have been land tortoises, similar to those which have been long known in the Dumfries quarries, and which are fully described in Dr. B.'s Bridgewater Treatise. A space of between 20 and 30 feet horizontal, is exposed in the quarry, on which these footsteps are distinctly seen, and where the animals do not appear to have been walking in the ordinary way, but to have been performing gambols. He stated also that from the appearance of the surface of the sandstone, covered with minute spherical elevations quite different from any ripple mark, it was manifest that a shower of rain had fallen, and its traces had been preserved upon this primeval surface!

Rev. G. Young presented a paper *on the antiquity of organic remains*, to which Prof. Sedgwick replied.

Dr. Buckland read a paper *on the application of small coal to economical purposes*. Mr. Oram had succeeded in agglutinating the small particles of coal into a firm mass by a process at once simple and cheap. There would even be economy in using this coal for many purposes, as it occupied one third less space, when packed, than coal in its ordinary state.

A letter was read from Mr. Fox, of Cornwall, stating the important fact, as a result of some new and most careful experiments, that *he had at length obtained, by voltaic action* upon mineral substances, *a mineral vein*, namely, carbonate of zinc, in its natural position between two layers of earthy matter.

Mr. D. Milne read a paper *on the Berwick and North Durham Coal-field*. It is a basin, 15 miles in diameter, and has 15 seams of coal, of the average thickness of 2 or 3 feet.

Major Jervis gave an account of the progress and present state of the *trigonometrical survey in British India*. Capt. Washington then gave an account of the government surveys of Austria, England, France, Saxony, Tuscany, &c.

Capt. W. Allen, R. N. read a paper *on a new construction of a map of the western portion of Central Africa, showing the possibility of the river Tehadda being the outlet of the lake Tchad.*

Capt. Beaufort, R. N. communicated a notice *on the position of the city of Cuzco, in Peru*, by J. B. Pentland, Esq.

Lieut. Col. Chesney, R. A. communicated a letter *on the recent ascent of the river Euphrates*, by Lieut. Lynch.

*Geological excursion.* Two steam boats were provided for an excursion to Tynemouth and Cullercoats. At 7 A. M. of Friday, about 200 gentlemen left the quay. After breakfast, at Tynemouth, many gentlemen and ladies from the vicinity, joined the party, which then proceeded under Tynemouth Castle rock along the shore to Cullercoats; Mr. Hutton and Prof. Sedgwick acting as leaders, and explaining as they advanced, every object of interest which presented itself. The party halted repeatedly, while Prof. S. directed attention to some singular phenomena there exhibited. A more picturesque scene can hardly be imagined than the Professor mounted on the beetling cliff, overhanging the vast ocean, with the listening hundreds assembled around him. After viewing the magnesian limestone, and associated red sandstones, the wonders of the 90-fathom dike, and the marl-slate beds at Whitley quarries, with their fossil fish, which had been opened up for the occasion, the party returned to Newcastle, much instructed and highly delighted.

On Saturday, the time was so limited, that instead of reading the remaining papers, their authors briefly stated the most important topics which they contained.

### Section D. *Zoology and Botany.*

The secretary read a paper, *on a species of fish having four eyes, found on the coast of Surinam*, by W. H. Clarke and John Mortimer. There appeared to be some uncertainty as to the correctness of the account, and it was proposed that the matter should receive farther examination.

Mr. Babington read a paper *on the Botany of the Channel Islands.* Mr. B. stated that 20 species of plants were found on these Islands not yet noticed in England.

Mr. J. E. Gray read a short description of *a British Shell, supposed to be new.*

Rev. Mr. Wailes exhibited a specimen of the rare insect *Psalidognathus Friendii*, concerning which some discussion followed.

Mr. Gray read a paper *on the formation of angular lines on the shells of certain Mollusca.*

A paper was read *on the wild Cattle of Chillingham Park*, by J. Hindmarsh. There are in this herd, 25 bulls, 40 cows, and 15 steers of various ages. They are beautifully shaped; have short legs, straight backs, horns of a very fine texture, thin skin, so that some of the bulls appear of a cream color. They have a peculiar cry, more like that of a wild beast than that of ordinary cattle. The eyes, eye-lashes, and tips of the horns alone are black, the muzzle is brown, and the inside of the ears red or brown, and all the rest of the animal white. The author was inclined to consider these animals the survivors of the Caledonian cattle, which undoubtedly extended through the northern provinces of England; and that, under the protection of the owners at Chillingham, they had escaped the general destruction dependent on the advance of civilization.

Next was read a paper on the production of *Vanilla in Europe*, by Prof. Morren, of Liege.

Dr. Parnell read a paper on some *new and rare specimens of British Fishes*, viz. Gadus cimbrius, Pagellus acarine, Raia chagrinea, R. intermedia, R. clavata, Cottus scorpicus, Platessa limandoides, P. pala, Mugil chelo, Trigla gurnardus.

The next paper was by Mr. J. Hancock, *on the Falco Islandicus* of authors. Mr. H. stated that under this name were confounded two distinct species. For the Iceland species he retained the name of *F. Islandicus*; the other he named, from the country in which it is most abundant, *F. Grœnlandicus*.

Col. Sykes read a paper on *a rare animal from South America.* It was described by Azara, and called *Canis jubatus*. It differed from the dog tribe in its nocturnal and solitary habits; its tail was thicker, more bushy, head flatter, eyes smaller, nose sharper, and the whole animal more bulky than the dog tribe. If it differed from the dog, it differed more from the fox and wolf, and he proposed to refer it to the genus Hyæna.

The next paper was *on Vegetable Monstrosities*, by Rev. W. Hincks. These he distributed into five classes. 1. Cases of coherence and adherence of parts not usually united, or of separation of those which are ordinarily connected. 2. Anomalies depending on the comparative development of parts of one circle. 3. Anomalous transformations of organs. 4. Monstrous exuberances of growth, by which the number of parts is altered independently of transformation, the number of circles of parts is increased or the axis irregularly extended. 5. Anomalous abortions or suppressions of parts usually present in the species.

Mr. T. P. Teale read a paper *on the Gemmiferous bodies and Vermiform Filaments of Actiniæ.* He stated that as great differences of opinion existed among zoologists, as to the nature of the gemmiform bodies and vermiform appendages of Actiniæ, he had undertaken their investigation. Some general remarks on the structure of the Actiniæ were premised, the author pointing out, by means of a large diagram, the various directions of the muscular septa, some lining the cavity and supporting the stomach of the animal, whilst others, more delicate, terminate in a mesentery, supporting the *gemmiferous bodies* (about 200 in number) or what has been erroneously called the *ovary*. The vermiform filaments are attached by a delicate mesentery to the internal body of each gemmiferous body. Many more valuable and curious details are given, for which we have no room.

A paper was read by Capt. J. E. Cook, R. N., on *the genera Pinus and Abies*, not less than 70 species of which had lately been introduced into England.

Mr. Hope read a paper entitled "Remarks on the modern classification of Insects."

Mr. G. B. Sowerby laid before the Section specimens of *Encrinus moniliformis*, displaying various monstrosities of form.

A paper was read by Mr. Arthur Strickland on the *Ardea alba*, a bird which is unquestionably an occasional visiter in England.

Prof. Ehrenberg addressed the meeting in French, and exhibited the first volume of his great work on microscopic forms of life. He submitted to the inspection of the members a bottle of the material collected in quantity in the vicinity of lake Lettnaggsjön, in Sweden, which the inhabitants call Bergmehl, or mountain meal. This earth, which resembles fine flour, has long been celebrated for its nutritious qualities, and was found to be entirely composed of the shells of microscopic animalcules. Prof. Jones engaged in an oral discussion with Prof. E. concerning the structure of the polygastric infusoria.

Rev. L. Jenyns exhibited a series of specimens of the square-tailed shrew, (*Sorex tetragonurus*, Herm.) and also a specimen of the chestnut shrew, (*S. castaneus*, Jen.) which was, in his opinion, a distinct species.

Mr. Gray made some observations *on the boring of Pholades.* The action of these animals in boring rocks he was inclined to consider mechanical.

Sir Wm. Jardine read the report drawn up at the request of the Association *on the present state of our knowledge of the Salmonidæ of Scotland.*

Mr. Allis, of York, read a paper *on the Toes of the African Ostrich, and the number of phalanges in the toes of other birds.* Mr. A. had not been able to find the rudiments of a third toe, alleged to exist in the Ostrich. He further stated, that Cuvier had erroneously given the number of phalanges of the toes of the following birds. In the Cassowary, which had 3 toes, the real numbers are 3, 4, and 5. In the Ostrich 4 and 5. The Caprimulgus has the outer and middle toe, having 4 phalanges each. The Swift has only 3 phalanges, except in the hallux. The Humming-bird has the full number of phalanges in all its toes.

Dr. Charlton showed a specimen of *Tetrao Rakkelhan* of Temminck, and endeavored to substantiate the old theory, that this bird is nothing but a hybrid between the hen capercailzie and blackcock.

Dr. Handyside, of Edinburgh, presented a paper *on the Sternoptixineæ, a family of osseous fishes*, including a minute description of a new species, the *Sternoptix cælebes.*

The next paper was *on the distribution of the terrestrial Pulmonifera in Europe*, by Edward Forbes.

A notice of *the annual appearance of some of the Lestris tribe (Arctic Gulls) on the coast of Durham*, was communicated by Edward Backhouse, Esq., of Sunderland.

Mr. Owen stated some of the results of his investigations made in procuring materials for his *report on the Marsupiata.* The report was drawn up under three heads. 1. The zoology of the Marsupiata. 2. Their relation to other Mammalia, and 3. The peculiarities of their reproductive economy. He concluded with some geological account of the bones of these animals.

Mr. Yarrell gave a description of a new species of Smelt, caught in the bay of Rothsay, which he denominates *Osmerus Hebridicus.*

Rev. F. W. Hope read a paper *on Noxious Insects occurring in* 1838. These were a beetle (*Anthonomus pomonus*) which attacked the blossoms of apple trees; an aphis, which has injured apple trees, hop plants, and wheat; and the *Tipula Tritici* (or rather *Cecidomyia Tritici*), a small dipterous insect, whose attacks on wheat while blossoming, for many years past, are well known.

## Section E. *Medical Science.*

A paper was read by Mr. T. M. Greenhow, on the beneficial action of mercury rapidly introduced, in certain cases of Neuralgia.

Mr. R. M. Glover read a paper on the functions of the rete mucosum and pigmentum nigrum in the dark races, and particularly in the Negro; with observations on a paper on the same subject, by Sir Everard Home.

In the next paper, Dr. John Reid gave an account of an *experimental investigation of the functions of the Eighth Pair of Nerves.*

A paper, by Mr. N. Farr, *on the law of recovery and mortality in Cholera Spasmodica*, was read by Dr. R. D. Thomson. From the tables which Mr. F. has prepared, may be deduced the solutions of the following problems. 1. The mean duration of the disease. 2. The mean future duration of the disease at any period. 3. The probability of dying at any period of the disease.

Mr. James Blake then read a paper *on the action of various substances on the animal economy, when injected into the Veins*, in which were detailed experiments with various substances and their effect on the vascular system, measured by an ingenious instrument, which the author called a Hæmadynamometer, an instrument by which he was enabled to detect the pressure of the blood in the arterial system, by means of a column of mercury, contained in a bent glass tube, which could be connected with the arteries, and which was attached to a graduated scale.

Dr. Yellóly (the chairman) showed a model of an improved acoustic instrument, to assist in cases of partial deafness. A report upon its value may be expected at the next meeting.

Dr. Reid gave a brief notice of his researches *on the quantity of air required for respiration.*

Dr. Inglis read a paper containing *phrenological remarks on the skull of Eugene Aram.*

Dr. Granville exhibited an *improved Stethoscope*, a ball-and-socket joint being attached to the ear-piece, which thus becomes movable with the cylinder at any angle which may be required.

Dr. Rees read a paper *on the chemical nature of the Liquor Amnii.*

Dr. R. D. Thomson read a paper *on the modus operandi of Nitrate of Silver as a caustic and therapeutic agent.*

Mr. Greenhow read a brief *memoir on fractures*, for the purpose of introducing a model of a new sling fracture bed, applicable to every fracture in the lower extremity, but peculiarly adapted to the treatment of compound fractures of the femur.

Dr. Bowring communicated some *observations on Plague and Quarantine made during his residence in the East.* The results of his observation had produced in his mind a strong conviction of the non-contagiousness of the plague. Quarantine restrictions are consequently altogether useless vexations.

Mr. Goodsir read a paper *on the origin and subsequent development of the human teeth.*

A paper by Dr. Spittal was read, entitled "Experiments and Observations on the cause of the Sounds of Respiration."

Dr. A. T. Thomson read a paper *on the medicinal and poisonous properties of some of the Iodides.* The principal preparation whose action was detailed, was the iodide of arsenic. The action of this medicine in very minute doses, from $\frac{1}{8}$ to $\frac{1}{6}$ of a grain, was peculiarly serviceable in Lepra vulgaris and chronic impetigo. A case of numerous tumors resembling carcinoma was found to yield to its continued action, and it was found equally successful in a more decided case of incipient carcinoma.

## Section F. *Statistics.*

The first paper read was a Report from Mr. J. Stephens, superintendent of police, *On the State of Crime in Newcastle, during the last ten months.* This was simply such a return as is usually made from police offices.

Mr. G. R. Porter read a *statistical View of the recent progress and present amount of mining industry in France.* This is an elaborate Report, and comprises the mining operations in coal, iron, lead, silver, antimony, copper, and manganese.

Col. Sykes read a very minute and detailed account of the *Statistics of Vitality in Cadiz.* He submitted an immense mass of valuable tables and returns, which will probably be published.

Afterwards were read *Statistical Illustrations of the Principal Universities of Great Britain and Ireland*, by Rev. H. L. Jones. The best authorities were employed in the preparation of this document. The college revenues were minutely detailed, and the results may be thus stated:—

| | Oxford. | Cambridge. | Dublin. |
|---|---|---|---|
| Heads of houses | 24 | 17 | 1 |
| Income | £18,350 | £12,650 | £2,000 |
| Fellows | 557 | 431 | 25 |
| Income | £116,560 | £90,330 | £25,400 |
| Scholarships | 339 | 793 | 70 |
| Income | £6,030 | £13,390 | £2,100 |
| College-officers | 199 | 179 | 10 |
| Income | £15,650 | £17,750 | £20,000 |
| Benefices | 455 | 311 | 31 |
| Incumbents | 430 | 280 | 31 |
| Income | £136,500 | £93,300 | £9,300 |
| Rent of Rooms | £11,730 | £15,860 | £2,000 |
| College Revenues | £152,670 | £133,268 | £31,500 |

Other tables were constructed, giving the number of members, and their ranks, also the *stimulating forces*, that is, the amount of pecuniary advantage offered for exertion.

Mr. W. Cargill offered a paper *on the Educational, Criminal and other Statistics of Newcastle.*

Mr. L. Hindmarsh made a communication on the *State of Agriculture and Agricultural Laborers in the north division of the county of Northumberland.* On the whole, the agricultural statistics of this district are of a gratifying character. They present a soil well cultivated, under the vicissitudes and difficulties of a very variable climate; and a peasantry who, in their general intelligence and moral habits, are a credit to themselves, an honor to the country, and an example worthy of imitation.

Dr. W. C. Taylor read *an Account of the changes in the population of New Zealand*, communicated by Saxe Bannister, Esq. late Attorney general for New South Wales. The New Zealand group consists of the N. and S. islands, Stewart's island, and some smaller isles; the extent of these is 95,000 square miles. The population was classed under the following heads,—natives, white residents, white visitors and mixed races. The probable number of natives is 130,000. The white residents are about 2,000. As many as 1000 British and American sailors have been seen at the Northern island at one time. There was no estimate of the mixed race, which is greatly on the increase; but the total population is decreasing, from a variety of causes, and chiefly from the introduction of European diseases. The natives are a noble race of men, capable of attaining a high degree of civilization, but in Mr. B.'s opinion, there was no doubt of their being addicted to cannibalism.

Mr. Rawson read a report *on the Fires of London.* The total number of alarms of fire attended by the Lond. Fire Engine Establishment during five years up to the end of 1837, was 3,359, or 672 on the yearly average: of these, 343, or 68 per annum, were false alarms, and 540, or 108 per annum, were fires in chimneys. Thus, the number of alarms was 13 per week, and of actual fires, 4 in every three days. Some of the false alarms had arisen from displays of the *Aurora Borealis.* Of the 2,476 fires, the premises were wholly consumed in 145 cases; seriously damaged in 632; slightly damaged in 1699. An analysis was given of the presumed causes of total destruction, and it was observed that the number of fatal fires had greatly increased. The winter months do not show so large a preponderance of fires as might be expected. December presents the largest average, but the next in order is May. On comparing the number of fires occurring on each day of the week, it appears that there is a slight excess on Friday, and a decided falling off on Saturday. In relation to hours, the number of fires is at the minimum, from 5 to 9 A. M., when it begins slightly to increase until 5 P. M., at which hour the rate of increase becomes considerable, and continues until 10 or 11 P. M., when the number is at the maximum; from this time it gradually declines until the dawn. The number of wilful fires in the five years, was 31, or 6 per annum, which is as 1 in 64 to the number of fires of which the causes were discovered.

Rev. J. M'Alister gave a *Statistical notice of the Asylum for the Blind,* recently established at Newcastle.—Mr. Heywood, announced that he had received the last *Annual Reports of the Regents of the University of the State of New York,* from the Rev. Dr. Potter, with an explanatory letter,—which was read.—Next was read Mr. Rawson's abstract of the *second Report of the Railway Commissioners for Ireland.*—Statistical tables were exhibited of the *nine principal collieries in the county of Dur-*

*ham*, prepared by Mr. W. L. Wharton.—Next was read Mr. Wilson's *account of the Darton collieries "Accident Club,"*—a kind of mutual relief association.—Mr. Felkin, of Nottingham, read an abstract of the *Annual Report of the overseers of the township of Hyde*, in Cheshire.—Mr. W. R. Charlton submitted *Statistical notices from the parish of Billingham.*—Mr. Hare offered an *Outline of subjects for statistical inquiries.*—Mr. P. M'Dowall presented *statistical tables of Ramsbottom*, near Bury in Lancashire.—Mr. Kingsley read a paper giving a tabulated *view of the Criminal Statistics of Ireland.*

### Section G. *Mechanical Science.*

A paper was read on a *new Day and Night Telegraph*, by Mr. Joseph Garnett; and a paper on *Isometrical Drawing*, by Mr. Thomas Sopwith.

Mr. Sopwith also gave a description of an *improved method of constructing large Secretaires and Writing Tables.* The principle is, that by opening a single lock, all the drawers, closets and partitions are opened. These are so disposed, that a person may reach every thing contained in it, without stirring from his seat. The president, (Mr. Chas. Babbage,) and many others, expressed their admiration of the arrangements, and of the convenience which such a table must be to every person engaged in an extensive correspondence, or having many sets of papers on various subjects.

Mr. G. W. Hall on the power of *economising and regulating heat for domestic purposes.*—Mr. John S. Russell gave some further notices on the *resistance of water.*—Mr. P. Nicholson communicated an essay on *the principles of oblique bridges.*—Mr. W. Greener submitted *remarks on the material and mechanical construction of steam boilers.* He considered the accidents which happen to steam boilers to be mainly due to defect in the material; and he detailed several experiments made on slips of iron cut from plates of different quality. He found that slips cut latitudinally from a plate, bore less by 30 per cent. than slips of the same dimensions cut longitudinally.

Sir John Robinson spoke on the *use of coal-gas for cooking.* Mr. Strutt, of Derby, stated some years since, that coal-gas would probably be found, by the lower classes, the cheapest fuel for cooking. The whole apparatus, (which might be considered the converse of the Davy Safety Lamp,) consisted in fixing a piece of wire-gauze at the extremity of a gas-pipe of about 6 inches diameter. Bulk for bulk, gas costs more than coal, but the former was more economical and convenient for occasional use and the smaller operations in cooking.—Mr. Evans gave account of a *new rotatory steam-engine*, invented by S. Rowley.—Dr. Lardner stated the reasons which had prevented the making of the experiments for the *Report on Railway constants*.—Mr. J. Price communicated an *improved method of constructing Railways*. The method consists in fixing rails on a continuous stone base, a groove having been made in the stone to receive a flange or projection of the lower side of the rail. The stones and rails are to break joint with each other, and the chair by which the rails are to be secured, is to be made fast to the rail by a bolt not riveted, but slipped in. The chair is to be sunk until the top is level with the top of the stone, and fastened to it by two small wooden pins. Any sinking of the road is to be obviated by driving wedges of wood underneath the stone, until it is raised to the required height. The chairs are to be fixed at about 4 feet apart, and to weigh, if of malleable iron, 14 pounds, but if of cast iron, 20 pounds: the rail to weigh 50 pounds per yard.

Mr. T. Motley presented a paper *on the construction of a railway with cast-iron sleepers as a substitute for stone blocks, and with continuous timber bearing*. The cast-iron sleepers, which are wedge-shaped and hollow, having all their sides inclined inwards towards the under side, are to be laid transversely, and the timber is to pass longitudinally through the center, and to be secured by wedges of iron and wood. The sleepers are to be six inches apart, and the timber of such a thickness as to prevent any perceptible deflexion between the rails. The road is to be ballasted up to the top of the sleeper, and the timber to stand out sufficiently, and to have any approved rail laid upon it.

Mr. Hall described a *machine for raising water by an hydraulic belt*. Mr. Samuda gave an account *of Cliff's dry gas-meter*. Mr. T. Sopwith described his method of constructing *geological models*. Mr. S. also described an *improved levelling stave*, for subterraneous as well as surface levelling. The mode of reading the figures of the stave itself instead of the sliding vane, as adopted by most engineers and surveyors, is used in Mr. S.'s improved staves; the figures being engraved on copper plate, on an enlarged scale. Mr. T. Motley gave an account of a *suspension bridge over the Avon*, Tiverton. The peculiar feature of this bridge is, that each chain is attached to the roadway, and the suspending bars are carried up through each chain above it. The length of the bridge is 230 feet, the breadth 141, and the cost, including the towers and land abutments, under 2,400*l.*

Prof. Willis described his instrument called the *Odontograph*, designed for enabling workmen to find at once the centres from which the two portions of the tooth are to be struck, so that the teeth may work truly together.

Mr. Lang described some improvements in *Ship Building*, and exhibited models illustrating the safety keel, which had been introduced with great success.

Count Augustus Breunner communicated a paper *on the use of wire ropes in deep mines.* About seven years ago, ropes composed of twisted iron wire, were introduced into the silver mines of the Hartz mountains, as a substitute for the flat ropes previously in use. Since that time they have been adopted in most of the mines of Hungary and Austria, to the almost total exclusion of flat and round ropes made of hemp. These iron ropes are as strong as a hempen rope of four times the weight. One has been in use upwards of two years without any perceptible wear, whereas a flat rope performing similar work, would not have lasted more than a single year. The diameter of the largest rope in common use in the deepest mines of Austria, is one inch and a half. This rope is composed of iron wires, each *two* lines in diameter; *five* of these are braided together into strands, and *three* of these strands are twisted tightly into a rope. Great care is requisite in making the rope, that the ends of the wires be set deep in the interior of the rope, and that no two ends meet in the same part. The strength of these ropes is little less than that of a solid iron bar of the same diameter. The usual weight lifted is 1000 pounds. The rope on leaving the shaft, must be received on a cylinder of not less than eight feet diameter, and be kept well coated with tar. There is a saving of about one third of the power in one case mentioned, for *four* horses with a *wire* rope, are doing the same work as *six* horses with a *flat* rope.

Mr. Babbage called attention to some specimens of a new method of wood engraving, by Mr. G. Woone.

Dr. Lardner addressed the meeting *on Steam Navigation and on a self-recording Steam-Journal.* Dr. L. said that it was a matter of no real importance how far any opinion which he might have formerly expressed on extended navigation was right or wrong, except so far as it had been made a personal question. He had, indeed, expressed a discouraging opinion as to the probability of ever maintaining an unbroken intercourse by steam navigation between Great Britain and New York, but he had never declared that it was a physical impossibility. He confessed that the success of the *Great Western* had shaken his former opinions, and should the same success continue throughout the entire year, he would be the first to come forward and acknowledge himself completely in error. He then gave an account of his instrument, termed a *steam-journal,* by which he proposes to register every five minutes, the following varying phenomena, on which the efficiency and performance of steam engines depends: —the pressure of the steam between the slides and the steam valve—the pressure in the boiler—the vacuum and the quantity of water in the boilers—the saltness of the water in the boilers,—the velocity of the paddle-wheels—the draft of the vessel—the trim of the vessel—the rate of the vessel,—the course of the vessel,—the apparent force and direction of the wind. All these, excepting the course of the vessel, it is intended to register by self-acting mechanism.

Mr. J. S. Russell followed with an essay on the same general subject, and insisted on the propriety of making steamboats sharp. Iron boilers, with copper tubes, appeared to him the best.

Mr. Fairbairne described *machinery for riveting boiler plates,* by which the work is done better and much more speedily than in the usual methods.—Mr. B. Green gave an account of the construction of *timber viaducts.*—Prof. Willis described a method recently introduced, by Mr. Hawthorn, of working the valves of a locomotive without the usual eccentrics.—Mr. J. T. Hawkins described several methods of filtering water.—Several communications were offered which could not be read for want of time, viz. Mr. Reed, *on an improved safety hook and bow for coal-pits:* Mr. Glynn, *on the waterworks of Newcastle:* Mr. Wake, *on a new paddle-wheel:* Sir C. Monteith, *on a new tram-road;* *on an improved kitchen grate:* Mr. Fourness, *on coal mine ventilation:* Mr. Dobson, *on a method of making bricks of every required color.*

Various appropriations were voted for the prosecution of scientific investigation, viz.

| | |
|---|---|
| To the Physical Section, | £2263.10 |
| Chemical " | 150.00 |
| Geological " | 325.00 |
| Zoological and Botanical, | 6.00 |
| Medical, | 100.00 |
| Statistical, | 300.00 |
| Mechanical, | 598.00 |
| | £3742.10 |

The principal recommendations not involving grants of money were—that Prof. A. D. Bache should be requested to report on the meteorology of the United States:—that Prof. Johnston should report on the connexion of Geology and Chemistry:—that the Council should prepare a general report on the progress of Geology:—that J. E. Gray, Esq. should prepare a report on British molluscous animals and their shells:—that P. J. Selby, Esq. should prepare a report on British Ornithology:—that Dr. Forbes should report on the Pulmoniferous mollusca of Great Britain; and that Prof. Faraday, aided by a Committee, should report on the specific gravity of steam. In addition to these, many resolutions were passed, involving applications to the government and other public bodies; and various scientific researches were also recommended.

## Art. IX.—*On Cupellation, an easy, an accurate, and new method;* by W. W. Mather, Mining Engineer, and Geologist.

TO PROF. SILLIMAN.

*Dear Sir*—My duties as mining engineer, metallurgist, and geologist, have frequently rendered it necessary to assay lead and other ores for silver and gold. As I could not procure a good cupelling furnace with muffles, &c., and as it was frequently desirable to ascertain on the spot, whether certain ores contained the precious metals, I have thought of other means of cupellation, and have succeeded in one which can be applied at any place where a candle, a common mouth blowpipe, and a slip of mica can be procured. It is a method which I have employed for about two years with perfect success, and I have no hesitation in recommending it to the public. As it is a matter of public interest to simplify all such operations, I have thought it proper to send you a description of my method of cupellation.

If the ore to be examined for silver or gold, be a lead ore, it is to be reduced to the metallic state by the ordinary methods. A small piece of the lead, of the size of a duck shot or larger, is to placed on a thin slip of mica, and then melted by the blowpipe flame of a candle or lamp. As the heat increases above the melting temperature of the lead, the globule will become perfectly brilliant, and finally a peculiar flickering, brilliant surface will shew itself, caused by the oxidation of the metal and the fusion of the oxide of lead. The oxide of lead melts at the temperature at which this appearance is developed, and spreads itself on the mica. It soon ceases to *spread*, and collects around the globule of melted lead, which is continually diminshing in magnitude, in consequence of the oxidation of the metal in the oxidizing blowpipe flame. When the globule of melted lead is nearly buried in the mass of the surrounding oxide, the slip of mica should be permitted to cool. The globule of lead should then be removed by forceps, or other means, to another place on the slip of mica, where the same oxidizing process is to be repeated successively. Finally, when the globule shall have been reduced to the size of a small grain of sand, it should be placed on a fresh, clean slip of mica, and again heated in the same manner. If the lead contains the least trace of silver, it is easily made manifest in this way, because, the silver when once free of lead, (which continues to oxidize to the last,) remains unchanged, as a brilliant white globule, which can be frequently seen distinctly with the naked eye, and when too small for this, by examination with the magnifier. If the oxidation of one globule of the lead does not give decisive indications of silver, a satisfactory conclusion as to the lead being argentiferous or not, may be obtained by oxidizing five to ten such globules down to a very small size, and then uniting these by fusion on a slip of mica, and continuing the oxidation to its ultimate limit. A person accustomed to blowpipe manipulation, can determine in a few minutes, if silver be present in any lead which may be suspected to contain it. With the table blowpipe, or the hydrostatic blowpipe, an ounce of lead may be cupelled in a very short time, and the relative quantity of silver determined, if it be appreciable.

If the ore to be examined be not an ore of lead, some of the ore is to be melted in a clean crucible which has never been used, and lead free of silver and gold added, and stirred and mixed with the fused ore. The fusion of the ore should be so perfect as to permit the lead to settle to the bottom of the melted ore. The lead, in consequence of its affinity for the precious metals, unites with them if present, and forms an alloy. The lead, cupelled as above, will show the silver or gold, or an alloy of them, if either, or both of them were present.

If the globule obtained by the cupelling operation be suspected to be an alloy of silver and gold, it is examined in the usual way, and the metals separated qualitatively, or quantitatively, as circumstances may require.

Albany, Oct. 2d, 1838.

## Art. X.—*Meteoric Observations made at Cambridge, Mass.*; by Prof. J. Lovering.

The science of meteorology, although it has received of late a large share of public attention, still remains in an unsettled and crude state. The rigorous demonstrations of mathematics, which have been called in to elucidate and develope the other sciences, have failed in any important degree to reach and establish this. A disposition to speculate, a disinclination to keep up steady observations, has been felt as a constant impediment to the growth of this department of science. It is not till very recently, that any regular and systematic plan of observations has been adopted: and yet we might have supposed that the mighty impulse given to astronomy by the establishment of fixed observatories, would have suggested similar means for the advancement of other sciences equally dependent upon constant observations. Instead of complaining, however, that we did not have them sooner, perhaps we ought rather to rejoice that such means are now in operation, and that a mass of observations is continually sent forth from these established retreats, which must soon give a more finished character to the complicated and difficult science of meteorology.

A good proportion of this attention has been received by that class of transient and luminous appearances, either in or very near to our atmosphere, comprehended under the general term of meteors. The appalling spectacle of falling stars, presented on the morning of the 13th November, 1833, has confirmed this awakening interest to the phenomena that are daily taking place in our atmosphere. This shower, for such it literally was, seems to have been quite unparalleled, if we make allowance for the exaggerated accounts which we read in the poets, of marvels and strange lights in the heavens. And what particularly needs notice, is the vast extent of country to which this sight was offered, suggesting the idea that the earth in its revolution, had encroached upon a nest of meteors. I have never been able to fall in with the opinion, that this shower has been repeated on the same morning in succeeding years. I do not think that the appearances noticed on those mornings were of an unusual character, and far less that they can claim any comparison with the exhibition of 1833. The hypothesis more recently advanced, that there are two or three favored seasons of the year, although better supported by the facts than the other, I do not think can yet be maintained. My own observations, and the facts mentioned by those who have arrived at a different opinion, have led me to the conclusion, that meteoric appearances are much more common every night than has been imagined: that, independently of the clearness of the atmosphere, no season of the year is especially provided: that about the same average number can be seen every fair night: that very few appear before midnight, and that much the largest number is seen during the two hours before sunrise.

Notwithstanding the zeal of observers in different places, many more observations are still needed, made every night in the year, and from midnight till morning, before any satisfactory result can be reached. The labor of such observations is painful, and must therefore be shared with many. I think, however, that a single night's uninterrupted watch is worth far more than the same extent of observations distributed over several evenings, as it saves the necessity of taking an average, which must always be uncertain; for although, generally speaking, the meteors fall much more abundantly in the morning, from four till six, than at an earlier hour; still, the relative proportions for each hour are not so accurately fixed, that we may conclude from a single hour's observation, the number that has fallen during the night. With these remarks, I give the result of some observations that were made at Cambridge, on and near the 13th of November last. Eight members of the senior class, Messrs. Hale, Hurd, Adams, Longfellow, Chase, Channing, Morison, and Parker, undertook the labor of watching. Their stations were taken together out in an open field: the heavens were divided into quarters, and two observers stationed at each quarter. All of the observers were out the whole time, from midnight till morning. A condensed table of the meteors seen by them is contained below.

*November 12th*, 1838.

| Hours of observation. | Quarters in which the meteors were first seen. | | | | Sum. |
|---|---|---|---|---|---|
| | S. E. | S. W. | N. E. | N. W. | |
| From 12 till 1 A. M. | 6 | 2 | 1 | 2 | 11 |
| " 1 — 2 " | 4 | 9 | 4 | 10 | 27 |
| " 2 — 3 " | 18 | 10 | 8 | 11 | 47 |
| " 3 — 4 " | 13 | 16 | 10 | 14 | 53 |
| " 4 — 5 " | 12 | 18 | 8 | 10 | 48 |
| " 5 — 6 " | 2 | 7 | — | 4 | 13 |
| Total, | 55 | 62 | 31 | 51 | 199 |

Note.—After 5 o'clock there were only two observers.

*November* 13*th*.

| Hours of observation. | Quarters in which the meteors were first seen. | | | | Sum. |
|---|---|---|---|---|---|
| | S. E. | S. W. | N. E. | N. W. | |
| From 12 till 1 A. M. | 6 | 7 | 3 | 8 | 24 |
| " 1 — 2 " | 12 | 11 | 6 | 8 | 37 |
| " 2 — 3 " | 7 | 7 | 1 | 9 | 24 |
| " 3 — 4 " | 11 | 5 | 4 | 6 | 26 |
| " 4 — 5 " | 7 | 7 | 3 | 3 | 20 |
| Total, | 43 | 37 | 17 | 34 | 131 |

*November* 14*th*.

| Hours of observation. | Quarters in which the meteors were first seen. | | | | Sum. |
|---|---|---|---|---|---|
| | S. E. | S. W. | N. E. | N. W. | |
| From 1 till 2 A. M. | 6 | 3 | 2 | 1 | 12 |
| " 2 — 3 " | 16 | 22 | 13 | 15 | 66 |
| " 3 — 4 " | 23 | 21 | 25 | 11 | 80 |
| " 4 — 5 " | 14 | 18 | 15 | 16 | 63 |
| " 5 — 5h. 20m. " | 3 | 8 | 0 | 1 | 12 |
| Total, | 62 | 72 | 55 | 44 | 233 |

An attempt was made to watch again on the morning of November 23d, but the clouds partially prevented. The observations this morning were not commenced till 1h. 20m. At half past two it became cloudy, and at three the sky was almost entirely obscured.

| Hours of observation. | Quarters in which the meteors were first seen. | | | | Sum. |
|---|---|---|---|---|---|
| | S. E. | S. W. | N. W. | N. E. | |
| From 1 till 2 A. M. | 2 | 5 | 8 | 5 | 20 |
| " 2 — 3 " | 10 | 6 | 5 | 4 | 25 |
| " 3 — 3½ " | 2 | — | — | 3 | 5 |
| Total, | 14 | 11 | 13 | 12 | 50 |

It is now to be remarked that the state of the atmosphere was not peculiarly favorable, on any one of the nights of observation. It was occasionally hazy, and floating clouds were continually obscuring some part of the firmament. It was thought, however, that the morning of the 13th was as favorable in this respect as either of the other mornings, and yet it happened that a smaller number was seen then than before or after. It was particularly noticed that the meteors of the 13th were inferior in splendor to some observed on the other mornings. For many of them had tails and trains, and shone with the brilliancy of Sirius.

Now it is clear that no conclusion is to be drawn from this or any other single set of observations. They are only valuable in connexion with all others made at the same or any other time. We still want a continued series, extending through every day of the year, and reaching from midnight till sunrise. Without these data, we are not prepared for the question whether one period or any number of periods is particularly supplied with meteors; nor are we competent to investigate the cause of these phenomena. A longer series of observations has been made in Germany than elsewhere, and, as far as they go, they seem to indicate an equal and uniform distribution of meteors throughout the year. No hypothesis can be received which aims simply to account for what are considered by some periodic showers; since no one can deny that meteors are seen every clear night in great abundance; and no theory is complete or exhausts the subject, which leaves these unexplained.

The members of the Senior class whose names I have given above, and by whom the observations at Cambridge were made, deserve an honorable mention for the zeal and fidelity with which they have discharged their trust. The notes which I have before me permit me to see from what point of the heavens each meteor first became visible, and in what direction it afterwards moved. I have carefully examined to discover, if possible, some common source or other circumstance which could lead to a generalization. The observations made at the same season of the year in other places have appeared to indicate a remote connexion with the constellation Leo. I find on looking with this view at my observations that a larger number of meteors emanated from this part of the heavens than any other, although the constellation Leo is so large that this fact will hardly lead to any inference. But what particularly struck me was the fact that so large a proportion of the meteors *radiated* to Leo. I find that the directions of more than two thirds, if traced back, converge to this part of the ecliptic. It is but fair to remark, however, that the remainder are exceedingly anomalous and deviate widely from the mark. It is a point to be carefully taken notice of by future observers, whether there be any general radiating point, whether it is fixed if there be one, in regard to the horizon, as it would be if connected with the earth's magnetic axis, or whether it partakes of the apparent diurnal motion of the stars: and especially whether it be the same at all seasons of the year. The connexion in so great a proportion of cases between the November meteors and the constellation Leo, has suggested the idea that the meteors have only an *apparent* motion; for the earth itself, at that time moving towards Leo, would give every foreign body which it should meet the appearance of coming from Leo. If a cloud of nebulous matter beset the path of the earth so as to be traversed by it, the denser parts might be condensed into different nuclei and the earth's atmosphere grinding by them might possibly set them on fire. The appearances under such circumstances would resemble those actually witnessed in a great number of instances, and we should also be able to account for the great abundance of meteors seen two hours before sunrise; as at that time we ourselves are facing the point to which the earth is moving, and must take directly into the atmosphere around us the encountered cloud. Till midnight we should have the earth between us and the vapor, and could only see the small quantity that escaped, being taken up in front and passed off at the sides of the earth. If every one of the observations made at Cambridge had indicated one radiating point without any exception, I should not consider them alone as sufficient foundation for any theory. As it is, what I have said will only bear to be thrown out as a suggestion, and will serve to fix attention more strongly on this part of the subject. It is desirable that observers at other seasons of the year should notice whether the radiating point shifts with the direction of the earth's motion, as it will do if the motion of the meteors is only apparent and proceeds from our own motion in revolution. I have enlarged these remarks much beyond my intention: my only object has been to do a part, however humble, in settling one of the many questions involved in meteorology.

Cambridge, December 6, 1838.

## ART. XI.—*Notice from* DR. ROBERT HARE, Professor of Chemistry, &c., *respecting the fusion of platina, also respecting a new Ether, and a series of gaseous compounds formed with the elements of water.*

TO PROF. SILLIMAN.

Philadelphia, Dec. 15th, 1838.

*My Dear Friend,*—I send you for the Journal a brief notice of some results, observations, and inferences, which are nearly in the same language in which they were communicated to the Chemical Section of the British Association for the Advancement of Science.

I have by improvements in my process for fusing platina, succeeded in reducing twenty five ounces* of that metal to a state so liquid, that the containing cavity not being sufficiently capacious, about two ounces overflowed it, leaving a mass of twenty three ounces. I repeat that I see no difficulty in extending the power of my apparatus to the fusion of much larger masses.

When nitric acid or sulphuric acid with a nitrate is employed to generate ether, there must be an excess of two atoms of oxygen for each atom of the hyponitrous acid which enters into combination. This excess involves not only the consumption of a large proportion of alcohol, but also gives rise to several acids and to some volatile and acrid liquids.

It occurred to me that for the production of pure hyponitrous ether a hyponitrite should be used. The result has fully realized my expectations.

By subjecting hyponitrite of potassa or soda to alcohol and diluted sulphuric acid, I have obtained a species of ether which differs from that usually known as nitrous or nitric ether in being sweeter to the taste, more bland to the smell, and more volatile. It boils below 65° of F., and produces by its spontaneous evaporation a temperature of 0 – 15° F. On contact with the finger or tongue it hisses as water does with red hot iron. After being made to boil, if allowed to stand for some time at a temperature below its boiling point, ebullition may be renewed in it apparently at a temperature lower than that at which it had ceased. Possibly this apparent ebullition arises from the partial resolution of the liquid into an aeriform ethereal fluid, which escapes, both during the distillation of the liquid ether and after it has ceased, at a temperature below freezing. This aeriform product has been found partially condensible by pressure, into a yellow liquid, the vapor of which, when allowed to enter the mouth or nose, produced an impression like that of the liquid ether. I conjecture that it consists of nitric oxide, so united to a portion of the ether as to prevent the wonted reaction of this gas with atmospheric oxygen. Hence it does not produce red fumes on being mingled with air.

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* Troy weight. The actual quantity fused was 12,250 grs.; the lump remaining weighed 10,937 grs.

Towards the end of the ordinary process for the evolution of the sweet spirits of nitre, a volatile acrid liquid is created which affects the eyes and nose like mustard, or horse radish.

When the new ether as it first condenses is distilled from quicklime, this earth becomes imbued with an essential oil which it yields to hydric ether. This oil may be afterwards isolated by the spontaneous evaporation of its solvent. It has a mixed odor, partly agreeable, partly unpleasant. From the affinity of its odor and that of common nitrous ether, I infer that it is one of the impurities which exist in that compound.

The new ether is obtained in the highest degree of purity, though in less quantity, by introducing the materials into a strong well ground stoppered bottle, refrigerated by snow and salt. After some time the ether will form a supernatant stratum, which may be separated by decomposition. Any acid, having a stronger affinity for the alkaline base than the hyponitrous acid, will answer to generate this ether. Acetic acid not only extricates but appears to combine with it, forming apparently a hyponitro-acetic ether.

I observed some years ago that when olefiant gas is inflamed with an inadequate supply of oxygen, carbon is deposited, while the resulting gas occupies double the space of the mixture before explosion. Of this I conceive I have discovered the explanation. By a great number of experiments, performed with the aid of my barometer gauge Eudiometer, I have ascertained that if during the explosion of the gaseous elements of water any gaseous or volatile inflammable matter be present, instead of condensing there will be a permanent gas formed by the union of the nascent water with the inflammable matter. Thus two volumes of oxygen, with four of hydrogen, and one of olefiant gas, give six volumes of permanent gas, which burns and smells like light carburetted hydrogen. The same quantity of the pure hydrogen and oxygen with half a volume of hydric ether gives on the average the same residue. One volume of the new hyponitrous ether under like circumstances produced five volumes of gas.

An analogous product is obtained when the same aqueous elements are inflamed in the presence of an essential oil. With oil of turpentine a gas was obtained weighing per hundred cubic inches 16$\frac{5}{10}$ grs., which is nearly the gravity of light carburetted hydrogen. The gas obtained from olefiant gas, or from ether, weighed on the average, per the same bulk 13$\frac{5}{10}$ grs. The olefiant gas which I used weighed per hundred cubic inches only 30$\frac{5}{10}$ grs. Of course if per se expanded into six volumes it could have weighed only one sixth of that weight, or little over five grains per hundred cubic inches. There can therefore be no doubt that the gas obtained by the means in question, is chiefly constituted of water, or of its elements in the same proportion $H^2O$.

With a volume of the new ether, six volumes of the mixture of hydrogen and oxygen give on the average about five residual volumes. The gas created in either of the modes above mentioned does not contain carbonic acid, and when generated from olefiant gas appears by analysis to yield the same quantity of carbon and hydrogen as that gas affords before expansion.

These facts point out a source of error in experiments, for analyzing gaseous mixtures by ignition with oxygen or hydrogen, in which the consequent condensation is appealed to as a basis for an estimate. It appears that the resulting water may form new products with certain volatilizable substances which may be present.

From the account of the proceedings of the Section, published in the Atheneum, it appears, that after my letter, in which the facts above mentioned were stated, was read, a Mr. Maugham, who is employed to exhibit the hydro-oxygen microscope at the Adelaide Gallery, London, asserted that I had accomplished the fusion, of which mention has been above made, by means of a blowpipe of his contrivance, which I had purchased while in London.

The opinion which I am obliged to entertain of an individual capable of this groundless assertion, would cause me to consider him unworthy of notice, had not his misstatement been made before an assemblage which I most highly esteem, and had he not been honored by a premium for his pretended invention by a respectable British Society.

The blowpipe which is thus falsely alleged to have been used by me, differs immaterially from one of which I published an engraving and description in the American Journal of Science for 1820, vol. ii, p. 298, being a modification of that originally contrived by me and republished in Tilloch's Philosophical Magazine, vol. xiv, for 1802.

Between the instruments described in these publications, or in the Franklin Journal, and that employed by Maugham, the only difference worthy of notice is, that the latter is near the apex bent so as to form an acute angle, and is thus rendered suitable for directing the flame upon a revolving cylinder of lime.

Although I purchased of Newman a blowpipe bent as described, with an apparatus attached for holding and turning a cylinder of lime, *I have never made any use of it*, having for the purpose of subjecting lime to the flame, found my modification above referred to as described in this Journal, preferable. It only required the jet pipe to be directed upwards in an angle of about forty five degrees with the axis of the lime cylinder.

I do not consider the form of my blowpipe employed by Mr. M. as qualified for the fusion of any metal.

It is remarkable that an apparatus of gasometers employed by Maugham at the Adelaide Gallery for the supply of the gases for the blowpipe differs but little from the apparatus proposed for the same purpose in my communication above adverted to, and published nearly twenty years ago.

However the process by which I have lately extended the power of the hydro-oxogen blowpipe may differ from those to which I had previously resorted, it differs still more from that modification which Maugham has claimed as his own.

## Art. XII.—*Letters on Steam Navigation;* by Junius Smith, Esq.:—with a *Letter to the Editors*, from Mr. Henry Smith, of New York.

### LETTER I.

TO MR. HENRY SMITH.

*My Dear Sir*—Since I wrote to you respecting masts for steam ships, I have, on more mature deliberation, satisfied myself that they are better without any masts at all. It may be expedient in the present stage of Atlantic steam navigation, to construct what may be called a deck mast, that can be thrown up upon a hinge, or bolt axis, in case it should be wanted. I do not doubt that more power is lost by the resistance of masts and rigging in steam ships, than is gained by the use of sails. I am aware that it will be said that the sails relieve the engines; but upon the same principle, the resistance occasioned by the masts and rigging, distress the engines in proportion to the degree of resistance and the time of its continuance. The truth is, as I apprehend it, the engines, if properly constructed, will perform their duty just as well without the aid of sails as with it. Every one at all accustomed to the seas, must be aware that a steam ship running off at the rate of ten knots an hour, would so far keep ahead of an ordinary breeze, that sails would have no effect in propelling, whilst the resistance of the masts and rigging would have a constant and a considerable effect in retarding her.

In crossing the Atlantic one way and the other for twelve months, how few days out of the three hundred and sixty five would a ship have so strong a wind, and that a fair one, as to enable her to run ten knots an hour under canvas? And if the wind is not strong enough and fair enough to do that, sails can be of little or no use. If, as is contended, the use of sails does relieve the engines, all that can be meant by that is, that you can lessen your steam power and reduce the consumption of fuel. But I think that advantage will be more than counterbalanced by the constantly increased resistance arising from the use of masts and rigging.

Your ob'dt serv't,

Junius Smith.

London, Sept. 19, 1838.

### LETTER II.

*Dear Sir*—In my last letter I took the liberty to dismast steam ships generally, and thus to save the expense of masts, sails, rigging and top hamper in the first place, and in the second, the constant disbursements necessary to keep them in working condition. My main object, however, was to show that masts in steam ships are worse than useless, because the resistance being constant, and the advantage only occasional, the loss by resistance exceeds the gain by such power. But I do not suppose the view I have taken of several particulars relating to Atlantic steam navigation, will receive, at present, the countenance of the public; because the erroneous opinions generally entertained are both so deeply rooted and so agreeable to the minds of many, who fear their craft is in danger that they do not choose to have them corrected, but rather feel a secret delight in any thing which has the slightest tendency to strengthen and confirm them. The bursting of a boiler, an accidental fire, the wreck of a ship, or the loss of a crew, are events hailed with triumph by the class of persons of whom I am speaking. But if the hints that I have thrown out lead the public mind from that general mode of thinking to which the novelty of Atlantic steam navigation has given birth, to a more close investigation of the subject, we shall soon see our enemies disarmed and uniting with us in carrying out a system of navigation which meets the wants and promotes the welfare of mankind.

It is with the view of showing the subject in its largest dimensions and most important results, that I venture a few remarks upon *steam ships of war*.

It may seem premature, perhaps officious, to speak of the power of the sword, to measure the force of nations, and to weigh in our hydrostatic scales the fortunes of empires. But the thing throws itself upon us in such bold relief, that it seems impossible to conceal it. We are compelled, whether we will or not, to trace the outlines, to bring the subject under review, and to anticipate the mighty effects of steam power upon the destinies of nations.

*Whatever nation, England, France, or America—and I think that it will be one of the three—has the largest and greatest number of steam ships of war, will command the ocean.* Nothing can prevent it. In estimating the relative force of antagonist fleets, the inquiry will not be, how many frigates, or how many line of battle ships were engaged? but, how many *steam ships*? It will be felt at once that the power of the fleet depends upon the latter. Those who were spectators of the last continental war, will remember that notwithstanding every effort was made and enormous expense incurred by the transport board to meet the urgent demands of the army, yet such were the delays arising from head winds, tempestuous weather, detentions in port, and long passages, that the sufferings of the army were sometimes appalling and its operations crippled.

In war, the facility of transportation is tantamount to victory. If a fleet of twenty steam ships can transport an army of twenty five thousand men to the American coast in fifteen days, and to the continental ports in a time less in proportion to the distance, the army can land when and where it pleases. There is no detention in port, no delay in the passage, no hovering upon the coast, with light and baffling winds, and thus affording time for the enemy to collect the means of defence; but the steamers push at once into port, and are in possession of their object before the enemy can be aware of his danger.

The transportation of the munitions of war and the victualling stores is scarcely less important than that of the army itself. The great magazines will always be at home, whence daily supplies will be drawn with the same ease and regularity as if they were in the vicinity of the camp. The celerity of communication and its absolute certainty supersede the necessity of accumulating stores in a foreign country before they are wanted.

But the greatest triumph of steam power will be seen in those tremendous naval engagements which hereafter will settle and establish the sovereignty of the seas. Such is the locomotive power of a steam ship, that she can place herself in any position in reference to the enemy, can run down from the leeward or windward upon the bows or stern of a sailing man of war, and with broadside after broadside, riddle her fore and aft, annihilate the crew, and leave in her scattered wrecks an undeniable evidence of the irresistible power of a steam ship.

I know it will be said that the paddle-wheels of a steam ship are liable to be shot away, and thus disabled, she may become herself a prey to the enemy. But is she as liable to be disabled as a sailing ship? Suppose a shot were to pass through a paddle-wheel, it is not destroyed, and may not be materially injured;

but if it were utterly destroyed, the ship is not disabled. She can work with one wheel. You must therefore destroy both wheels before she is disabled.

How is it with a sailing ship? Dismast her, and her power is gone. She is a lost ship. The argument therefore regarding the danger of being disabled is vastly in favor of the steamer. She has no masts. And you must imagine her rash enough to expose herself unnecessarily to the enemy, and that too in such a manner as to give him an opportunity of carrying away both paddle-wheels, whilst his own masts are unscathed and entire, before she is disabled;—not a very likely thing, when we consider that the steam ship, by virtue of her locomotive power can always approach the enemy or claw off, when a sailing ship cannot do either. The power of sails is perfectly useless, and the sailing ships go into battle like so many dismasted ships, the sport and playthings of the lively steamer.

If a steamer man of war has occasion to board her enemy, she manœuvres not, waits not the favor of a wind, but darts upon her prey at any point she pleases, and her combatants march over the bridge of her own deck into the camp of the enemy.

The boilers of a steam ship of war ought to be below the loaded water line, and therefore perfectly secure from the effects of shot. The resistance of the water would effectually prevent the shot from penetrating, whilst the even keel of the steamer would give her a point blank shot at her enemy.

Think for a moment of a sailing ship of war, no matter how many guns, chasing a steamer, no matter how few, the longer she chases the further she is off, until, if it were possible to sail on an uninterrupted circle, the steamer in the very act of running away would overtake her pursuer. Reverse this picture, and fancy you see the steamer bearing down upon the seventy four under full sail. Can the latter quicken her speed? Can she fly in the eye of the wind? Can she escape before it? Has she the slightest chance of evading the combat? Can there be a doubt as to the result? When we consider steam power in time of war carried out into all its multiform ramifications, what merchantman can escape capture? What harbor afford shelter? What village resist plunder? What city destruction? What country invasion? Steam power alone can cope with steam power, and therefore the relative naval force of nations can be measured by no other scale.

Hence we see all the maritime nations upon earth reduced to the *same level*, and the work of destruction, upon a large scale, must begin afresh. All the existing navies of the earth are not worth a pepper corn. They will neither augment, nor diminish the power of a nation in any future maritime warfare. We may just stand upon their ruins, and witness kingdoms, empires, and republics, all starting anew in the career of naval achievements, and pressing forward towards those grand results which wait upon superiority.

Nothing but a steam power navy, in the present advanced state of steam navigation, can protect itself, much more a nation from insult. It would seem therefore preposterous and absurd, for any nation to exhaust its resources upon so useless and lumbering a thing as a sailing ship of war. The apathy with which this great subject is regarded in high places, if indeed it be regarded at all, is quite surprising. But the time is hastening on when its power will be *felt*.

England, in all the spreadings of her vast empire, her universal commerce, great in arms, great in peace; England, first in moral excellence, in mechanics, in manufactures, in literature, in the arts, in opulence, in every thing which exalts and adorns a nation, and I may be permitted, after a residence of more than thirty years in her metropolis, to say, all this and a thousand times more. England, with all this radiance encircling her crown, is at this moment more exposed than any other nation to the ruthless hand of the invader. It is not enough that she has strength to *crush* invasion, she wants the *power* to *prevent* it. That she can never have without a steam navy.

Your ob't serv't,
JUNIUS SMITH.

London, Oct. 19th, 1838.

*Remarks by the Senior Editor.*—It being obvious that certain objections to the views of Mr. Smith would present themselves to many readers, a letter, dated Dec. 3d, was addressed to his correspondent in New York, to which the following is an answer.

### LETTER III.

TO PROF. SILLIMAN.

*Dear Sir*—In reply to your queries I try to answer each in its order, commencing with "What for instance will the sparless, sailless ship do when in mid-ocean her machinery gives way, (perhaps the main axis of the wheels of motion,) or should her boilers burst, how will she get on then, and what will become of, it may be, two hundred or three hundred people or more; rolling about in the sea, when, their steam paddles being idle, they have consumed their provisions and do not speak any vessel?"

Answer. I do not understand Mr. Smith as doing away with the use of masts entirely, but only so arranging them upon a bolt axis or otherwise, that they can be unshipped or rigged at pleasure. The basis of his argument as I understand it is, that the great resistance which they meet in adverse winds, counterbalances the use of them, and therefore in doing away with the top hamper, they could be easily rigged so as to lie upon deck, to be used in case of need. If so rigged, the case you contemplate of "breaking the main axis of wheels of motion, or bursting of boiler," must be provided for by resorting to the movable masts. Steamers might have two or more engines detached from each other, as is the case with the British Queen, so that in the event of the bursting of one boiler or injury to one engine, the other would remain in full operation, and a case would hardly occur when both engines would be disabled at the same time.

The next question, "How are the great warlike steam navies to be supplied with fuel? Even if the countries have wood, that will last but a little while, as coal cannot be obtained in every maritime country, and if it could, enough could not be carried for a long cruise?"

Answer. Here again I understand that the plan of Mr. Smith for steam ships of war, is more one of defense than of aggression, and his argument seems based upon this position. I do not think he contemplated that steam ships of war would be sent on long cruises, but to be relied upon more as a means of defense.

The British Queen is one of our line of ships, and we have some expectation that she will arrive in January, yet she may not be here before February. It would afford me great pleasure to introduce you to the ship whenever she does arrive, and I shall not fail to inform you of it.

With much respect, dear sir, yours very truly,

Henry Smith.

New York, Dec. 12th, 1838.

## Art. XIII.—*On a New and Effectual Method of Preserving Specimens of Organic Nature, and of obviating the Blanching Influences of Light, and the Depredations of Insects;—most Advantageously Applicable to the Formation and Unlimited Preservation of a Hortus Siccus, or Museum of Dried Plants;* by John L. Riddell, M. D., Professor of Chemistry and Materia Medica, in the Medical College of Louisiana.

"Corpora non agunt nisi sint soluta."

It is conceded, I believe, that light exerts an influence in chemical changes, by modifying or exacting the inherent electrical energies of material particles. This influence has been observed times innumerable by every one, in the blanching or fading of organic colors. Few, I apprehend, could be found, who would be willing, upon the first proposal, to believe in the possibility of easily and completely averting this fading power of light, and of conferring immutability upon the organic tints which are considered as most delicate and evanescent.

The possibility of so doing may perhaps be made theoretically to appear, thus:—The particles of an absolutely solid body can suffer no change, because they are *inter se* immovable. A withering leaf, exposed to air and light, fades and decays, because there is moisture present. Liquid water fills myriads of its insensible pores and intercellular spaces. The leaf may be dry externally,—nay, it may be apparently dry within; yet it is really imbued with more or less of water. This water may give fluidity to the fading coloring matter, either by immediate solution, or by becoming impregnated with acid substances. But it is chiefly by absorbing, and thus giving liquidity to oxygen gas from common air, that it contributes to change. Besides, it is favorable to chemical action, by standing ready to dissolve and remove some or all of the eliminated products. Water, moreover, may exert an indirect agency in hastening organic changes, by favoring the existence of insects and animalcules. Light renders the chemical affinities concerned more active, and thereby soon accomplishes changes which time and other circumstances would accomplish without it. Those conditions only, on which the power of assuming the liquid state depends, are essential. Remove them, and no change can occur.

My plan consists in wholly abstracting the moisture from the specimen to be preserved, having previously inclosed it in some material impervious to air or moisture, in order that the condition of absolute dryness may be perpetually maintained. The desiccative substance which I make use of, is unslacked lime; and though other agents might be used, this seems to answer in all cases so perfectly well, as to leave nothing to be desired. Pure quick lime, it is well known, will absorb near one third its weight of water in the process of slacking, yielding a powder apparently as free from moisture as at first.

I will first explain the manner in which botanical specimens are to be framed for constant exposure on the walls of a museum or lecture room.

Take a specimen, recently dried in the usual way, between folds of bibulous paper, in order that every shade of color may be natural and fresh as life; procure a pane of glass of sufficient size, and a plate of tin, zinc, copper, or sheet lead,* half an inch longer and half an inch broader than the pane of glass; bend this around the edges so that it will embrace the glass; remove the latter, and place in the shallow cavity a thin layer of cotton batting; upon this, sift a thin stratum of the powder of quick lime; over this another layer of batting; upon this a sheet of tissue paper, and on the tissue paper, the specimen and label. Over all, place the clean pane of glass; press it gently down, and carefully turn over it the edges of the metallic plates. Secure the junction of the glass and metal with a ceroid or resinous cement, as bees' wax, shellac, or sealing wax: or what is more convenient, and seems to answer well, fill the crevices with stiff glazier's putty, and when that gets dry, pass over it with thick Japan varnish, of which two or three successive coats may be used. If the back be of sheet tin, zinc, copper, or thick sheet lead, a ring may be soldered to one end, for the purpose of hanging up without further preparation. But if very thin sheet lead be used, it may require to be first protected by a back of binder's board and some kind of frame.

With a view of subjecting theory to the test of experiment, I enclosed in this manner a dried specimen of *Lycopodium apodum*, and also attached a part of the same specimen by means of stick-ing wax to the outer surface of the glass. It was exposed to air and sunshine in a high and sheltered situation. After the lapse of two or three days, the outer specimen had obviously begun to lose its color, and was inclining to yellow, while the enclosed specimen, equally exposed to light, still retained its vivid green and apparent freshness. The outer specimen continued to fade until it became nearly decolored; but the enclosed one suffered not the slightest change in appearance.

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* The sheet lead which lines tea boxes answers very well.

It is not essential that the specimen should be dried previously to being thus enclosed. By increasing the quantity of lime to three or four times the weight of the substanee to be desiccated, a specimen just plucked may be carefully arranged beneath the glass—it may be then subjected for a couple of days to a few pounds of pressure, may be sealed up and never afterwards removed. The degree of perfection with which the most delicate tints of flowers can thus be preserved, is incapable of being surpassed. In the space of two or three days, the specimen generally becomes more thoroughly dry than it is practicable to render it by bibulous paper.

Upon carefully surrounding fresh specimens of Asclepias Drakeana* and Rosa Gallica, with fine powder of quick lime, in a close tin box, complete desiccation was accomplished in a single day; and I was agreeably surprised in finding, that the lime had not in the least modified any of the colors. The flowers were taken out of their natural shape and color, but stiff and brittle from dryness. It is sometimes rather difficult, however, to remove all the lime from some portions of the flowers. Probably it would be best to fill the interior of deep flowers with fine clean sand, before burying them in the powder of lime. In this way, fruits, fungi, insects, small fish, and even reptiles, may be effectually embalmed.

In common herbals the flower is rudely crushed; the important organs from which generic characters are drawn, are deformed, displaced, and often incorporated into a seemingly homogeneous mass; and the fine colors, if they do not become even completely faded, are never preserved for any great length of time without deterioration. Large specimens exhibiting the stem, branches, leaves, and mode of inflorescence, may well enough be kept in an herbal after the usual manner, with the precautions I shall soon point out; but for the preservation of most flowers and floral organs, I would recommend a plan like the following:—

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* Undescribed. Flowers yellow and crimson. Louisiana.

Throw into a jar which can be closely covered, samples of different flowers as they come to hand; immediately sift upon them finely pulverized quick lime, so as to bury them. Again and again throw in other flowers, covering them in the same way, until the jar is full. It may be well enough, for reasons already explained, to fill the cup of the flowers with fine writing sand, before covering them with lime. At any time the lime and flowers may be gently poured out, and the flowers, now perfectly dry, carefully picked up with little forceps. These flowers may be attached to twigs of trees or branches of sea fan or coral, and be enclosed with a few small lumps of quick lime in a sealed glass jar, in such a way that they can be conveniently inspected. Flint glass phials will answer very well for such as are small. A much neater method is to enclose them in the same way in a shallow box lined with metal, and covered with plate glass. In none of these arrangements, if the sealing be perfect and the lime good, will the flowers be noticed to fade from the influence of light.

The same principles may be applied in defending a common herbal from the depredation of insects and from further change by fading. In order to explain a method of effecting these desiderata, I will here introduce the plan which I am now about putting into practice myself. I procure those large tin boxes in which French silks are imported to this city. Any desirable number of them of similar size, can be bought here for a dollar a piece. They are near four feet long, by three feet broad and two feet high. A part of one side must be handsomely cut out for a door. This door may be made either of tin plate, or of a large pane of thick crown glass framed and sealed in metal. It must be attached to the box by hinges; its inner surface near the margin must present a continuous band of gum elastic; around the margin must be eight or ten fastenings, in order to close the opening completely, by pressing the opposing surfaces of metal upon the gum elastic. The door place might be rendered more substantial, by soldering around it such brass strips as are used in fastening down stair carpets; and corresponding strips might also be soldered upon the door itself. These boxes may be painted, and arranged on a series of handsome shelves. Besides containing the folios of botanical specimens, they must each contain a vessel partly filled with unslacked lime, which will always maintain when the door is kept shut, an inclosed atmosphere of such extreme dryness that *no living thing can exist there*, and no chemical change go on.

I am of opinion, that as botanists are in the habit of mutually interchanging specimens, they would find it greatly to their advantage to adopt a somewhat similar mode of enveloping the packages to be sent. The length of the tin or zinc boxes should be about twenty two inches, the breadth near thirteen, and the thickness from one to six inches. The opening for the cover may then be twenty one by twelve inches; and the cover, besides having six or eight nut and screw fastenings, may be cemented on by bees' wax or sealing wax. On each side the specimens next the metal, may be placed thin layers of powdered quick lime in cotton batting. In this way, no damage would be likely to occur to specimens in transportation. These boxes, having no other use, might be considered as belonging to the fraternity of botanists, rather than to individuals.

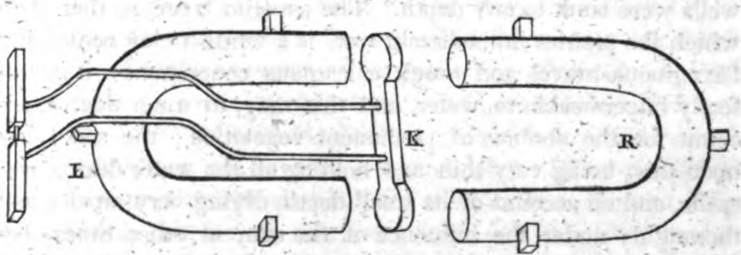
In conclusion, I cannot but anticipate that the mode of forming collections or museums of plants, by inclosing handsome specimens behind glass, will hereafter contribute greatly to the diffusion and improvement of botanical science. It is not my design, at this time, to set forth in detail the various excellences and advantages of such a method. To the reflecting reader they must be already obvious. The same principles may be beautifully applied in preserving bouquets of natural flowers, beneath glass bells, as mantel ornaments. The same plan cannot fail of answering admirably in preserving collections of insects. Even miniatures, larger paintings, documents, in short, almost any substance, whether of organic or inorganic nature, may be thus saved from the merciless hand of time.

New Orleans, November 26, 1838.

## Art. XIV.—*Electro-Magnetic Engine, constructed by the late* A. W. Campbell, of New Orleans,—communicated by Prof. Riddell.

This engine, now in my possession, was the result of two or three years of study and numerous experimental trials. Mr. Campbell was a teacher by profession. His opportunities for acquiring a knowledge of natural science were very limited, but his zeal and singleness of purpose are seldom exceeded. He died in January, 1838, leaving his design not quite finished.

His engine differs in some respects from those constructed by others. It consists essentially of two large and solid electro-magnets, of soft iron, in the form of the letter U, coated with coils of copper strips one inch broad by half a line in thickness. These copper coils are insulated by being wound with strips of paper. The electro-magnets weigh, each, about one hundred pounds, and are arranged horizontally, the opposing poles being about eight inches apart. Between them plays the keeper of soft iron, K, after the manner of a piston of a steam engine. When the magnet, R, is connected with an active pair of galvanic plates, K is attracted by its poles. A reversed current of the galvanic fluid from a smaller pair of plates, is then sent around the magnet, sufficient in quantity to destroy its magnetism the moment after the connection with the large galvanic pair is broken. At this instant the magnet L is made to attract the keeper; the connection is then broken, and the current reversed as before; and thus a returning horizontal motion is given to the keeper and its appurtenances. The connections are broken and reversed by the dipping of amalgamated slips of copper into mercury.



New Orleans, November, 1838.

## ART. XV.—*Miscellaneous Notices in Opelousas, Attakapas, &c.*; by Prof. W. M. CARPENTER.

Jackson, Lou., Nov. 8th, 1838.

TO PROF. SILLIMAN.

*Dear Sir*—I promised, some time since, to give you something on the prairie formation of the Opelousas and Attakapas country; but after an examination during two summers, I have not been able to find much that is worth reporting. The formation on which the prairies rest, is nearly the same as that extending east of the Mississippi River, and across the southern states to the Carolinas and Georgia. The age is evidently the same, and the only apparent difference is in the color of some of the layers, those on the east of the Mississippi being derived from the Alleghany Mountains, and all those west of the the river, having the deep ferruginous tinge peculiar to the sediment brought down from the Rocky Mountains. I observed layers of this kind as far west as the borders of Texas, wherever wells were sunk to any depth. The superior layer, or that upon which the prairies immediately rest, is a whitish clay containing ferruginous gravel and rough calcareous concretions; it is perfectly impermeable to water, and this may, in some degree, account for the absence of permanent vegetation; the soil lying upon this, being very thin and holding all the water during wet spells, and on account of its small depth, drying very rapidly and thoroughly under the influence of the sun, at other times, becomes subject to great extremes of saturation and drought. This may be one reason why the vegetation of these prairies is almost entirely of a transient nature; thus, in wet seasons, those plants are seen in abundance, which prefer wet localities, but these always disappear at the approach of drought. No plants are permanent except some hardy species of thorn trees, which bear these extremes, and even these are stinted. The drought is most injurious, for when a spot is shaded, trees grow to a large size. On all these prairies there are ponds, which, on account of the impervious nature of the clay, contain water at all seasons. They are often situated on the highest part of the prairie. They are surrounded by the Zizania, Thalia dealbata, Cyperus articulatus, and many other marsh plants. These ponds seem to be gradually filling up with vegetable matter, and are no doubt rich in fossils of the mastodon, and perhaps other animals. During the last summer I visited three localities, at which remains of the mastodon have been found, and obtained some pieces. At one place, a mile distant from the village of Opelousas, an entire skull was disinterred, but it crumbled on exposure to the air, and nothing remained except the teeth; it must have been very large. It was discovered in excavating, in very dry weather, in order to deepen one of these marshy ponds for the use of stock. At about six feet from the surface, they came to the head and some of the vertebræ, and then to a few ribs, all of which were in the natural position, indicating the erect posture. Unfortunately, rain drove them from the search, and on account of the increased depth of the pond it has never been dug since.*

A few days since, I visited a somewhat curious deposit of bituminized wood in this parish, (East Feliciana,) the bituminization being very perfect and very recent. It is at Port Hudson, on the Mississippi River. The following is a description of the place. The village is situated on a bluff, sixty or seventy feet high. This bluff reposes, as this whole country does, on a thick bed of blue aluminous clay, which forms the beds of most of our water courses, and wears very slowly by the action of water. At that place, the upper surface of the clay is considerably below high water. The bluff has been long falling in from being undermined by springs, which run out above the blue clay, and by the action of the current of the Mississippi; but the blue clay does not wear away near as fast, and for this reason it extends some distance beyond the base of the bluff. It seems that upon this shelf, the Mississippi has made a considerable deposit, of the common kind, containing a great many fragments, and sometimes entire logs; after this deposit took place, a considerable mass of earth must have fallen, covering the former one. The remarkably low water, together with the removal of the superincumbent earth to form a new landing place, has exposed the formation. The smaller logs are often entirely bituminized, and changed into a glossy black coal, in which no trace of fibre can be perceived; still the formation must be very recent, for in the most perfectly bituminized pieces there are frequent marks of the axe, looking as though it was done but yesterday. The limbs are very much flattened, but otherwise, their external appearance is the same as usual in the species, which can easily be determined, being oak, walnut, hickory, &c. The larger logs and fragments have undergone the transformation in various degrees; some being of a soft and spongy texture. Many are in the state of perfect coal at one end, or on one side, and have undergone no change except softening at the other.

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* In the low lands bordering on the Calcasin River and Sabine, there are numerous springs of petroleum.

## ART. XVI.—*On the Liquefaction and Solidification of Carbonic Acid*;[*] by J. K. MITCHELL, M. D.

IN the year 1823, public attention was strongly drawn to the subject of the liquefaction by pressure of the, so called, permanent gases, by Mr., now Sir Michael Faraday.[†] Among the aerial fluids, carbonic acid was distinguished as requiring a force of 36 atmospheres at 32° F. to coerce it into the liquid state. His ingenious and hazardous experiments were conducted in glass tubes; and he depended on the accumulation of newly generated gas for the necessary pressure.

Mr. Brunel,[‡] in a subsequent endeavor to apply compressed gases to mechanical purposes, produced a pint and a half of liquid carbonic acid, which, even at high temperatures, he confined in a series of small brass tubes not above the $\frac{1}{30}$ of an inch in the thickness of their walls.

This interesting subject was not again publicly agitated, until the appearance in December, 1835, of a report on the liquefaction of carbonic acid on a comparatively large scale. In the last number for that year of the *Annales de Chimie et de Physique*, M. Thilorier described the properties of liquid carbonic acid in detail. According to him, this liquid demands for its existence as such at 32° F., a pressure, as stated by Sir M. Faraday, of 36 atmospheres. Its specific gravity is at the same temperature 0.830, at —4° F.—0.900, and at 86°—0.600. It is therefore enlarged by heat 3.407 times as much as its own or any other gas, when carried from 32° to 86°. From —4° to 32°, its expansion is almost exactly equal to that of the gases.[§]

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[*] From the Journal of the Franklin Institute.

[†] Philos. Trans. Lond. [‡] Quart. Journ. Vol. XLI.

[§] See at page 301 of this number, a notice of Mr. Robert Addams' experiments on this subject, and that of Dr. Torrey, in our miscellany.—EDS.

M. Thilorier found also that the expansive force is altered by heat so as to amount at 86° to 73 atmospheres, and at —4° to 26 atmospheres. The density of the gas when resting over the liquid at 86°, is stated at 130 times the density of that which is compressed by the force of one atmosphere. Its pressure is therefore at 86° not much more than one half of that which its density would indicate.

When liquid, the carbonic acid is, on the same authority, immiscible with water and the fat oils, but is readily united with ether, alcohol, naphtha, oil of turpentine and carburet of sulphur. Although potassium decomposes it, lead, iron, copper, and the other easily oxidized metals, do not act on it.*

The thermometric temperature observed in the jet by Thilorier, appears to be erroneously stated; for, as the *solid* is, at its formation, not below —90°, and as the act of solidification of any vapor or liquid keeps the temperature, for the time, at the highest point compatible with the existence of the particular solid under observation, it follows that the jet of carbonic acid cannot fall below its freezing point. Immediately after its production, the carbonic snow begins to grow colder, and may be made to reach —109° in the air, —136° under an exhausted receiver. When moistened with ether, it can be depressed to —146°. Professor Hare's ether acts much more effectually than sulphuric ether.†

At the immediately subsequent sitting of the Academy of Sciences, Thilorier announced the important fact that he had solidified carbonic acid. This he effected by suffering the liquid to escape into a bottle, or box, where, by the sudden gasefaction of a part, the remainder was frozen by the extreme cold thus produced. The solid is white, light, evaporable, and excessively cold. Because, surrounded by an atmosphere of gas which is constantly escaping from it, a fragment of it touched lightly by the finger, glides rapidly as over a plane surface.

Its evaporation is so complete as to leave no other trace of moisture than that which is caused by the coldness and consequent atmospheric humectation.

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* Among the most remarkable of the phenomena observed by Thilorier, was the intense cold produced by the sudden liberation of the liquid and its conversion into gas. A jet of it depressed the thermometer to —130° F., and when sulphuric ether had been previously mixed with the liquefied gas, the refrigerating effects were more marked both on mercury and the sensations.

† See Dr. Hare's account of his Ether, at page 328, in this number.—Eds.

The force of its gasefaction is alleged to be equal to, but not so sudden as, that of gunpowder.

The temperature at which the solidification took place was presumed to be about —148° F.; although the experiments before the committee of the Academy shewed —124°.

Such is, in substance, the account by M. Thilorier of his novel and curious discovery, reported in the *Annales de Chimie*. No description of the method of procedure, or of the apparatus used, is annexed; and we are left to conjecture, and to the imperfect description of travellers, for any farther knowledge of either.

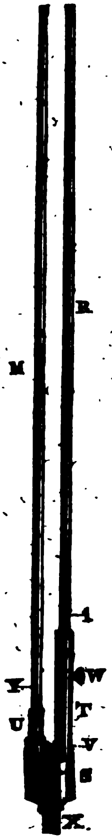
Having repeated the experiments of Thilorier, I deem it not useless to subjoin a draught of the instrument with which, aided by the suggestions of an intelligent pupil in France, and the assistance of friends here, I was enabled successfully to repeat most of the experiments of Thilorier, and to verify some, and correct other, of his results.

The apparatus consists of a generator of cast iron, A, supported by a wooden stand, B, a receiver, F, also of cast iron, connected to the generator by a brass tube, and fastened firmly to it by the stirrup screw, K; H, I, J, are stop-cocks, G, the nozzle of a pipe, L, a glass level-gauge, and S, M, R, a pressure-gauge.

The generator is 20 inches long and 6 inches in diameter exteriorly. Its cavity is 16 inches deep, and 3 inches, nearly, in diameter, so that it will hold about 4 pints. The walls are, of course, about 1½ inches in thickness. At the top, an aperture of two inches in diameter is closed by a strong wrought iron screw, the shoulder of which is let in about a quarter of an inch. The collar is of block tin, turned to the size of the shoulder of the screw. There is a hole in the head of the screw E for the reception of a long, strong iron bar.

The copper cup, N, 1¾ inches wide, and 9 inches long, holds about 12 fluid ounces. There is a little handle at the top, and a copper wire at the bottom, which makes the whole length a little less than that of the cavity of the generator. This cup is used to introduce the sulphuric acid.

The brass tube between the generator and receiver is divided into two parts of equal length, which admit of being united by means of a conical juncture, kept tight by the stirrup and screw, K, K. Each of these portions of the tube may be closed or opened at pleasure by a stop cock. One is placed at I, another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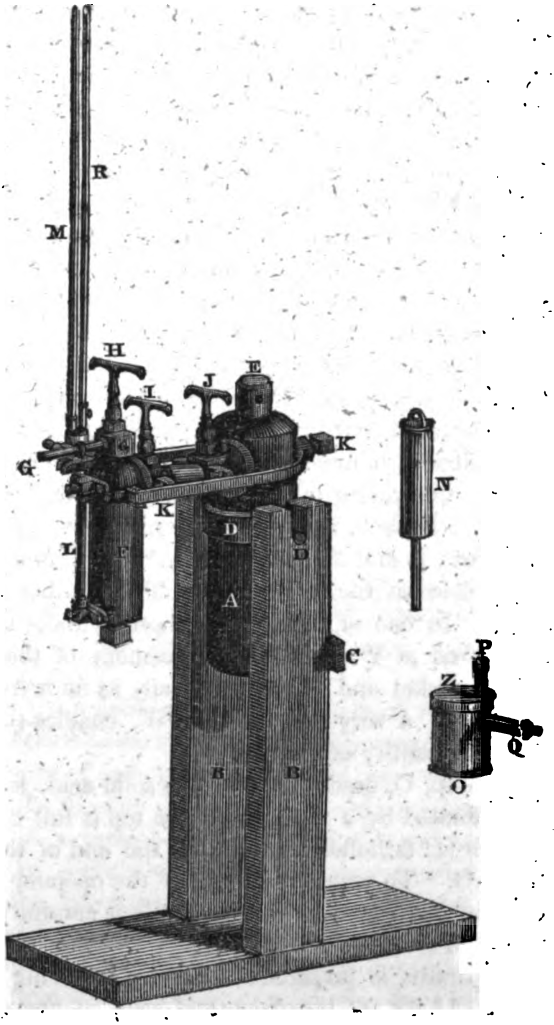
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at J; so that when the receiver is being separated from the generator, the contents of both may be retained. The stop-cocks in common use are inadequate to resist the pressure, and therefore a screw stop-cock is indispensable. It is made to close a small aperture by means of a conical point, and having a double cone, it closes an outlet also when the cock is completely open, so as to prevent the escape of gas by the sides of the screw.

The receiver, F, is of the capacity of about a pint. The pipe, G, G, turned at a right angle at G, descends so as almost to touch the bottom of the cavity in F. The stop-cock H, G, is similar to I and J. L is a glass tube connected at each end to a socket of brass, which communicates with the interior of F. It is the gauge for observing the level of the liquid in F.

The gauge for measuring the pressure is peculiar. Into a wrought iron box, S, are inserted, by screws, two sockets, T and U. The former descends almost to the bottom of the box, which is nearly filled with mercury. Through the axis of the screw, X, a small tube passes into the cavity of S, and is continued to the top of it, so as to rise above the mercury. Two strong barometer tubes, R and M, are cemented* into U and W, and hermetically sealed at the upper ends. These tubes are carefully graduated. In one of them, U, a short cylinder of mercury is made to stand at Y at the commencement of the experiment. The other, socket and all, is full of air, as no mercury is introduced into it. A very fine screw at W, enables the operator to regulate the quantity of air in T.

The tin cup, O, used to collect the solid acid, is covered by a lid, Z, perforated by a pipe, P, whose top is full of small holes. The handle Q, is hollow, so as to fit the end of the pipe of the receiver at G. To secure the hand of the operator from the cold produced by the experiment, the handle is carefully wrapped up in some kind of cloth.

The apparatus is prepared for use by removing the screw E, and placing 1¾ lbs. of bicarbonate of soda in the generator, A, to which 24 fluid ounces of water are to be added. After making these into a thin paste by stirring, 9 fluid ounces of common sulphuric acid are to be poured into the copper cup, N, and that is to be let down by a crook of wire into the generator. After the screw, E, has been firmly applied, and the stop-cock, J, closed, the contents of the generator are to be brought into admixture by moving it round to a horizontal position on the swivel D, which is supported by the wooden frame, B, B. There is a check bar at C. This motion is to be repeated several times. In about ten minutes the whole of the carbonic acid is liberated, and exists in A, chiefly in a liquid state.

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* The cement used was made of shell lac 3 or 4 parts, white or crude turpentine 1 part, melted at as low a temperature as possible, so as not to make bubbles in the mixture. This cement is very strong, but liable, without great care in the regulation of the heat, to have capillary tubes in it from the vaporization of the turpentine. This defect may be completely corrected by cutting away, when cold, the external mass of cement, and putting on a little common cap cement, which melts at a much lower temperature and closes the tubes.

The next step in the process is to attach, by means of the stirrup and screw, K, K, the receiver, F, *previously cooled by ice.* The keys, I and J, may then be opened slowly, and instantly the liquid carbonic acid is perceptible in the gauge, L. At the end of ten minutes, the communication with the generator may be cut off—when about eight fluid ounces of liquid acid at 32° F. will be found in the receiver.

By letting this liquid into the box, O, through the pipe, G, a large part of it is instantly expanded into gas, which escapes through the tube, P. The coldness consequent on the enormous expansion, freezes another part of the liquid, which falls to the bottom of O. About one drachm of solid matter is thus formed for each ounce of liquid.

The porosity and volatile character of the solid render its specific gravity of difficult ascertainment. When recently formed, it is about the weight of carbonate of magnesia, and when strongly compressed by the fingers, its density is nearly doubled. Solid carbonic acid is of a perfect whiteness, and of a soft and spongy texture, very like slightly moistened and aggregated snow. It evaporates rapidly, becoming thereby colder and colder, but the coldness produced seems to steadily lessen the evaporation, so that the mass may be kept for some time. A quantity weighing 346 grains lost from 3 to 4 grains per minute at first, but did not entirely disappear for three hours and a half. The natural temperature was from 76° to 79°. The solid is most easily kept when compressed and rolled up in cotton or wool. Its temperature when newly formed is not exactly ascertainable, because it is immediately lowered by evaporation. Thilorier seems to have entertained the opinion, that the greatest degree of cold was created at the time of the formation of the solid. In my experiments, a constant decrease of temperature was observed, which was accelerated by a current of air, or any other means of augmenting evaporation. At its formation, the carbonic snow depresses the thermometer to about —85°. If it be confined in wool or raw cotton, its cooling influence is retarded; if it be exposed to the air, especially when in motion, the thermometer descends much more rapidly; and under the receiver of an air pump, the effect is at its maximum. The greatest cold produced by the solid carbonic acid in the air was —109°, under an exhausted receiver —136°, the natural temperature being at +86°.

The admixture of sulphuric ether so as to produce the appearance of wet snow, increased the coldness, for the temperature then fell, under exhaustion, to —146°;* a degree of cold which we were not able to exceed by means of any variation of the experiment. That result is most easily obtained by putting about two fluid drachms of ether into the iron receiver before charging it. A compound liquid may be thus formed which yields a snow in less quantity, but of a more facile refrigeration. Alcohol may replace ether in either mode, but with less decided effect. In the air, the alcoholic mixture fell to —106°, and remained stationary. By blowing the breath on it, it fell to —110°. Left to itself, it rose slowly to —106°; but on being placed under an exhausted receiver fell to —134°.

Every attempt to wet the carbonic solid with water, failed, so that no estimate of its relative effects could be made.

The experiments resulting from the great coldness of the new solid, were very striking. Mercury placed in a cavity in it, and covered up with the same substance, was frozen in a few seconds. But the solidification of the mercury was almost instantly produced by pouring it into a paste made by the addition of a little ether. Frozen mercury is like lead, soft, and easily cut. It is ductile, malleable, and insonorous. Just as it is about to melt, it becomes brittle or "short," and breaks under the point of a knife. These facts may account for the discrepancies of authors on this subject. Frozen mercury sinks readily in liquid mercury.

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* As —146+32=178, the cold is nearly as far below the ice-point as 212 —32 =180 is above it.

At about —110° liquid *sulphurous acid* is frozen, and the ice sinks in its own liquid, and at —130° *alcohol* of .798, assumes a viscid and oily appearance, which by increase of cold, is augmented until at —146° *it is like melted wax.* Alcohol of .820 froze readily.

At —146° *sulphuric ether* is not in the slightest degree altered.

When a piece of solid carbonic acid is pressed against a living animal surface, it drives off the circulating fluids and produces a ghastly white spot. If held for 15 seconds it raises a blister, and if the application be continued for 2 minutes a deep white depression with an elevated margin is perceived; the part is killed, and a slough is in time the consequence. I have thus produced both blisters and sloughs, by means nearly as prompt as fire, but much less alarming to my patients.

The specific gravity of liquid carbonic acid may be estimated either by weighing a given measure of it in a tube, and deducting the weight of the tube, and of a superincumbent gas, or by means of very minute bulbs of glass as suggested by Sir M. Faraday. By the latter means I obtained the following results, which are compared with those of Thilorier.

| | | Thilorier. | |
|---|---|---|---|
| Temp. Fahr. | Sp. Gr. | Temp. Fahr. | Sp. Gr. |
| 32° | .93 | 32° | .83 |
| 43°.5 | .8825 | | |
| 51° | .853 | | |
| 74° | .7385 | | |
| 86° | | 86° | .60 |

The specific gravity particularly at 32°, was examined repeatedly, and with different bulbs, and always found to be at, or very near, to .93. The difference never amounted to .005. The sp. gr. as given by Thilorier at 32° is 83. The anomalous expansion of the liquid as indicated by both sets of experiments is truly surprising. By mine 73.85 parts raised from 32° to 74°, or 42°, become 93 parts, and gain 19.15 parts, while the same bulk of the gases acquires in the same range of temperature only 6.46 parts, or the liquid is expanded very nearly three times as much as its own or any other gas. According to Thilorier, 60 parts gain 23 parts by an elevation of 54°, while the same bulk of air would under like circumstances be augmented only by 6.75 parts; or the liquid is nearly four times as expansive as the gases.

As below 32°, or at reduced pressures, the augmentation of temperature is productive of much less expansive influence, we may infer that under the weight of a few atmospheres, as when near to its freezing point, liquid carbonic acid is scarcely more dilateable by heat than water. Between —4° and +32°, its expansion is 0.053 while that of air is 0.069. These facts suggest the inquiry how far water at *very high temperature and pressure* may be obedient to the same expansive influence, and thus by suddenly filling the whole interior of boiler, sometimes cause explosions.

The pressure of carbonic acid gas, when placed over its liquid, is given by Thilorier at 32° and 86°, as 36 and 73 atmospheres respectively. By means of the gauge, S, M, R,—I found the pressure as follows:

| | | |
|---|---|---|
| 32° - - - - | 36 | atmospheres. |
| 45° - - - - | 45 | do. |
| 66° - - - - | 60 | do. |
| 86° - - - - | 72 | do. |

The principle of the gauge renders it capable of registering the pressure with great accuracy;—for as one tube, M, begins to mark the pressure from the commencement of an experiment, and the mercury in the other, R, does not reach a visible point until the first has shown a pressure of several atmospheres, the second tube is equivalent in effect to one of several times its length. The first determines the amount of pressure, at which the mercury reaches the initial point on the 2nd, and the 2nd, subsequently, exhibits the multiplicators of that initial quality. Thus, if when the mercury is at five atmospheres in M, it is at the unit mark in R, the value of that unit will be five, and the numbers representative of the pressure on R, must be multiplied by five; or R is equal in effect to a tube five times its length. By these means very short tubes may be used to determine very high pressures. Inequalities in temperature, irregularities in the cement, and other causes, may vary the capacity of the socket T, W, but as M always signifies the unit for R, in each case, no error can arise from these causes. There must, of course, be a correction for the weight of the mercurial column in R, which is to be added to the product. Care must be taken to keep the temperature of the vessel which holds the liquid below that of the gauge and tubes, otherwise the liquid will be formed by condensation in the latter. This actually happened in the attempt to ascertain the pressure at 86°, when the natural temperature was 75°. Bubbles of gas were seen ascending through a liquid in M, up to its surface at a few inches below the mercurial cylinder. This as far as relates to the tubes may be avoided by prolonging the socket of M, down into the mercury of the cup, so as to include a cylinder of common air between two cylinders of mercury, and prevent any carbonic gas from entering either the socket, or the glass tube. A correction for the weight of this column, must in such case be made.

When a glass tube, hermetically sealed at one end, and cemented into a brass socket and screw at the other, is attached to a charged receiver and cooled by snow or pounded ice, liquid carbonic acid may be collected in it. It is perfectly colorless and transparent, and the specific gravity bulbs, previously introduced, are seen to ascend or descend, as the temperature is altered. When the tube so charged is opened, the liquid becomes violently agitated, escapes rapidly, grows colder and colder, and finally the remainder is converted into a solid, more dense than the snow already described, but nearly white, and very porous. If the tube be exposed to a paste of carbonic snow and ether, the liquid is solidified into a mass which is not porous but which sinks in the liquid as the latter is formed again by the melting of the solid.

The analogy between liquid carbonic acid and water, is thus completed for we have liquid, vapor, snow, and ice, exhibited by both.

By the previous introduction of water, ether, alcohol, metals, oxides, or oils, &c. into such tubes, and then filling them with liquid carbonic acid, the resulting phenomena may be easily observed. Water being heavier rests below the new liquid, and does not appear to mingle with it even at the surface of contact, for when the latter is let off no bubbles appear in the water, and it is frozen at the top into solid ice.

When alcohol or ether is introduced, the new liquid falls through it in streams, as water would do, but soon renders it milky by mixture. The removal of the pressure causes a violent effervescence, and immediately the clear, colorless ether, or alcohol, is seen alone in the tube; no solid being formed. When alcohol holds shell-lac in solution, the acid causes its precipitation in light whitish flocculi, which are immediately re-dissolved when the acid is suffered to fly off. Nothing remains but the brown lac-stained liquid.

Liquid carbonic acid did not appear to act on any of the metals or oxides, but the experiments on this point demand a further examination. Its inaction is probably owing to the want of the force of 'presence,' or of 'disposing affinity.'

When the liquid has been frozen in a tube of glass, the tube may be melted off by the blow pipe, and hermetically sealed. Such a tube will always retain the liquid, or gas, the former, if in sufficient quantity, at all temperatures, if not, the latter alone will be found in it at high temperatures. I have one such tube, which begins to show moisture at 56°, and exhibits a constantly elongated cylinder of liquid, as the coldness is increased. At 32° the cylinder is about half an inch in length.

Carbonic acid mechanically powerful as it is, is not applicable, perhaps, either to locomotion or projection; but though the reasons for this are most of them obvious, the Franklin Institute has appointed a committee to investigate and report on the subject, that the exact truth may be known, and the waste of time and talent likely otherwise to be experienced, be saved to the country.

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## Art. XVII.—*On a general Electro-Magnetic and Magneto-Electric Formula.*

Extracted from the Journal of Chemistry, by Erdmann and Schweigger Seidel, and forwarded for insertion in this Journal.

Mr. Schweigger repeated on the 26th of July, 1834, before the Society of Physiciens of Halle, several of the experiments which he had already performed in his public lectures in the University. He demonstrated by those experiments that a magnet turning around its axis, produces a greater accumulation of electricity than a couple of small disks of zinc and copper, of about the size of a half crown, (or half dollar,) and are wetted in a solution of muriate of soda. For whilst the current of this hydro-electric combination produced a constant deviation of the needle of 30° to 40°, they observed in turning the magnet, instantaneous deviations of 160° to 170°, and the magnet being continually turned, the needle finally stopped between 60° and 70°.

In those experiments Mr. Schweigger employed an electro-magnetic multiplier, formed of only six brass-wires, one twelfth of an inch in thickness, which we shall designate by AE, A′E′, A″E″, &c., and of which each was folded, as shows in the fig. 1, the line ABCDE. By means of small grooves filled with mercury, the extremities of these wires can be placed in communication in two modes, and thus send the current at will either from the first wire AE into the second A′E′; from this into the third A″E″, &c.; or in causing to communicate on one part all the extremities A, A′, A″, and on the other, the extremities E, E′, E″, through the six wires at once. In this last disposition, when the multiplier forms but one circuit, the current produced by the rotation of a magnet, and conducted to the multiplier by conductors of a pretty large mass, (thick bands of copper,) causes the needle to deviate instantaneously 80° to 90°, and if the needle continues to be turned, stops finally between 50° to 60°. If, the multiplier remaining the same, two disks of zinc and copper, wetted with a saline solution, are used, the constant deviation of the needle is but 10° to 15°.

Fig. 1.

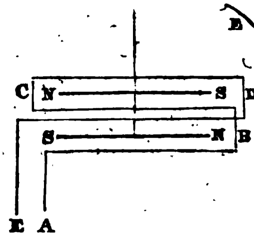


Fig. 2.

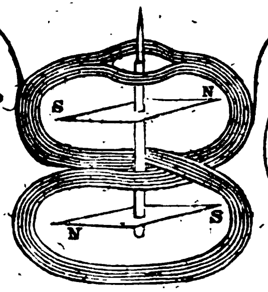
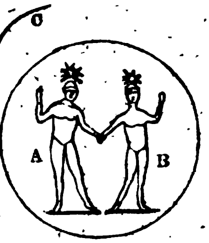


Fig. 3.*



An ordinary multiplier, of which Mr. Faraday made use, composed of numerous turns, and formed with a wire, thin, and very long, folded as shown by fig. 2, (that which, according to the Journal of Chemistry and Physics, by Mr. Schweigger, 1825, Vol. III, is the best form which can be given to it,) produces a deviation of only 10° to 15°, by the current of the same magnet turning round its axis. By a proper combination of several magnets turning around their axes, this same multiplier (fig. 2,) shows an increase of the electric force, whilst the multiplier, which we described in the beginning of this note, and is destined to measure the quantity of electricity and not its tension, indicates, on the contrary, a decrease of strength.

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* See J. S. C. Schweigger über Mythologie. Tab. I. Fig. 1.

Several variations of this experiment are easily deduced from the figure given above, (fig. 3,) which may be considered a general magneto-electric and electro-magnetic formula. In order to justify the idea of using the figure of man, we will request our readers to peruse what Mr. Pouillet says on the subject of the electro-magnetic figure of Mr. Ampere.* The two stars on the head of those two figures are the symbol of the two electricities at the moment they unite, and the position of the same figures indicates the movement of the electric spark, as going from above downwards, and it is in *fact* thus that lightning (foudre) ordinarily moves. They know that this movement, from above downwards, of the electric spark produces magnetization all around it and in a plane perpendicular to its direction, and the whole passes exactly in the same manner as if the magnetism *were* conveyed by an austral pole, (that is to say, the pole of a magnetized needle directed to the north,) which is conducted in the same plane on the left, (from the west southward, towards the east, &c.,) and by a northern pole inseparable from it, which is conducted to the right, (from the east southward, to the west, &c.) It is thus that the figure A turning to the left, is the symbol of the austral magnetism, and the figure B turning to the right, that of the northern magnetism.

It is seen then that the direction of the spark or of the electric current, is indicated by the situation of these two figures, and that the movement of these same figures expresses the situation of the magnetic pole according to all the tangents, which, as indicated by this motion, are all comprehended in a plane perpendicular to the direction of the spark. All that is essential to electromgnetism being thus explained, our design is evidently a general symbol of the electro-magnetic phenomena, or a general formula, the application of which to all particular cases is very easy.

But this design is also a general magneto-electric formula. If, for example, the south pole of a magnet enter into an helix of copper wire, it produces evidently a separation of the magnetic fluid, since the northern magnetism is attracted and the southern magnetism repulsed. In taking this movement of the northern and southern magnetism for the commencement of revolutions in opposite directions of the two figures, they can be put in the helix in a corresponding manner, the situation of the figures which result from it will account then for the direction of the electric current.

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* Pouillet, Elem. de Phys. exp. Paris. 1832. Tom. I. P. 2. p. 242.

If a southern pole, for example, is turned to the left around its axis, let us fancy the symbol of the southern magnetism introduced into the interior of the magnet in a situation corresponding to the direction of rotation: the electric current resulting from this, will be directed then from the head of the figure spoken of towards the feet. It is evident that the wire communicating to the southern pole, receives the northern magnetism at the place of contact, whether this contact is effected immediately or by the agency of the mercury. It will be seen that this wire will turn respectively to the right if the southern pole turns to the left, conformably to our symbol. And in effect, *is the essential point in this trial*, and departing hence, we can easily obtain a long series of varied and instructive experiments.

It is necessary to warn all those who intend to repeat them, to take all precautions to avoid thermo-electric currents, the multiplier described above being very subject to them. In effect, it can be easily demonstrated in experimenting in the manner indicated above, that the thermo-electric current is greater than an hydro-electric current produced by a single pair of zinc and copper disks, which are about equal in size to a crown, (or half dollar,) and are wetted with a solution of muriate of soda.

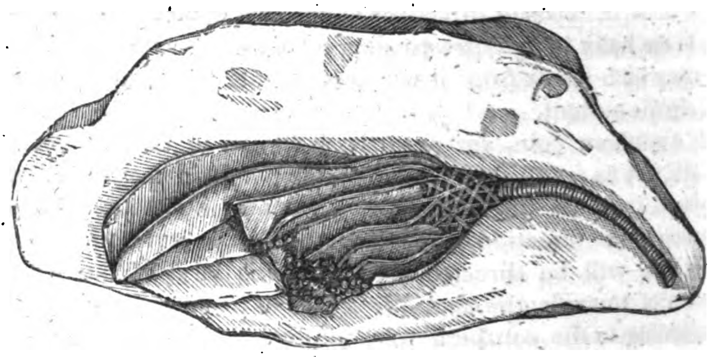
## ART. XVIII.—*Fossil Encrinite;* by JOHN G. ANTHONY.

Cincinnati, September 11th, 1838.

TO PROF. SILLIMAN.

*Dear Sir*—ENCLOSED I send you a drawing of a specimen in my collection, which I found near this place in March last. The first specimen of this fossil was discovered by myself a year since, and consisted merely of the reticulated part, without any stem, and but a small portion of the fimbriæ. During the past winter more than seventy similar specimens were washed out by the rains from the rubbish of a quarry, and picked up,—

the present is decidedly the best specimen which has rewarded our search.



For want of any systematic work on the fossils of our strata, I cannot venture to say whether it is described or not. It is undoubtedly one of the encrinite family, probably an apiocrinite, and the present drawing is forwarded for publication in your Journal, with a view to enable some one better acquainted with the subject to determine its specific name.

The letter accompanying the notice of Dr. Warden's trilobite in your July number,* is calculated to convey an erroneous impression that his species is entitled to priority. The statement made to me by Dr. W. was, that his sister received the specimen from some one, and had put it away with many others, without being aware of its true character, and that on his visit to Springfield about a month after he saw my specimen, he noticed this, and brought it away with him to Cincinnati. That Dr. W. was not aware of its existence previously, is evident, for he drew up the report alluded to in his letter, and therein says, "*it is undoubtedly the shield of an undescribed trilobite furnished with feelers or tentaculæ; this is a very important fact to establish, as it will prove conclusively, that the trilobite family are properly considered analogous to the crabs,*" &c. &c. Throughout the report he makes no allusion to any other specimen as bearing any analogy with it, or conflicting in any degree with its claim to priority. As this claim was set forth in my communication to the Academy, and as he takes no notice of it in his report, it is evident, that at the time, the existence of his sister's specimen was unknown to him.

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* Vol. xxxiv, p. 379.

## ART. XIX.—*Report on the Shooting Stars of December 7, 1838, with remarks on Shooting Stars in general.* By EDWARD C. HERRICK, Record. Sec. of the Conn. Acad. of Arts and Sciences.

AT the conclusion of the Report on the meteors of last August, (p. 173 of this vol.) it was stated that on the night of Dec. 6, 1798, Brandes witnessed a remarkably large number of shooting stars.* This fact was first communicated to me in April last, by Professor Loomis, of Western Reserve College. Believing that phenomena of this nature result from celestial causes more or less permanent, I at once entertained strong hopes and considerable expectation that a return of this display would *now* be seen on or about the same period of the year. I well knew that our knowledge of the true system of shooting stars was too imperfect to warrant the prediction, that a meteoric display which had been once observed, would ever after, in greater or less degree, be visible at the same season, *in all parts of the earth.* Yet the fact that since proper observations have been made, a season of meteoric abundance has been detected, about the 10th of August and the 13th of November,* added strength to my hopes. On the other hand, my confidence in the return of the display was somewhat shaken by the apparent absence of any other records of unusual meteoric appearances at this season. A *very extensive* search will probably bring some such to light, but if it should not, it will at least prove anew, how easily a phenomenon of this kind, when not specially watched, may pass unnoticed. However, the chance of a rediscovery of this long-lost shower, induced me to request several friends in various places, who had previously obliged me in a similar way, to keep up a vigilant watch at this season. Few returns have yet been received, and from some of the distant observers, they can not be expected under many months. The observations made in this city show conclusively that the number of meteors visible here about the 7th of December, 1838, was for several hours, from six to eight times beyond the average. Those detailed in the following table, were made here by Messrs. C. P. Bush, A. B. Haile, J. D. Whitney, B. Silliman, Jr., and myself. They comprise, with one exception, every favorable evening from the 4th to the 15th, inclusive.

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* The entire account of this display is given in the following extract, the original of which arrived to-day in a letter from Prof. Loomis. The work from which it is taken, is entitled, "Versuche die Entfernung, die Geschwindigheit und die Bahnen der Sternschnuppen zu bestimmen: von J. J. Benzenberg und H. W. Brandes. Hamburg, 1800. 8vo."—"It will be proper here briefly to relate an observation which I [H. W. Brandes] had an opportunity to make, while on a journey from Göttingen to my native place. As I was travelling, on the evening of the 6th of December, 1798, from Harburg to Buxtehude in an open post-wagon, I had the gratification of seeing a larger number of shooting stars than I had ever before witnessed. I first noticed them soon after the close of evening twilight, and having no other business, I kept count of the number which appeared in the small segment of the heavens which I could with convenience survey from my seat. For the sake of greater accuracy, at the end of every hundred, I noted the time by my watch, which there was just light enough to enable me to do. They appeared in such numbers that for about four hours, I counted as many as 100 an hour. Occasionally they came at a much more rapid rate;—often 6 or 7 in a minute. After this, [about 10 P. M.] they were much less frequent, and during the whole night, I saw only 480, although I had counted in the four first hours alone, over 400. In order to be certain that no one portion of the sky was richer than the rest, I looked occasionally at other parts of the heavens, but found no difference. I may, therefore, safely say, that on this evening, many thousand shooting stars must have been visible above my horizon."—It does not appear that Brandes noticed at this time any point of radiation; or that he watched in subsequent years for a return of the display. The idea of a periodical shower of meteors had then probably never been advanced.

### I. *Observations on Shooting Stars made at New Haven, Conn. December*, 1838.

| Date. 1838. | Time of observation. | No. of observers. | Quarters of the sky observed. | No. of meteors seen. |
|---|---|---|---|---|
| Dec. 6 | 8h. 8m. to 9h. 8m. P. M. =60min. | 1 | E. | 23 |
| " " | 10h. 5m. to 11h. 5m. P. M. =60 " | 2 | S. E. & N. N. W. | 32 & 12m. |
| " 7 | 0h. 20m. to 1h. 5m. A. M. =45 " | 2 | S. S. E. & N. W. | 10 & 15m. |
| " " | 4h. to 5h. A. M. =69 " | 1 | E. | 21m. |
| " " | 8h. to 9h. P. M. =60 " | 2 | E. & W. | 62 & 31 |
| " " | 9h. to 10h. P. M. =60 " | 2 | E. & W. | 43 & 28 |
| " " | 10h. to 11h. P. M. =60 " | 1 | N. E. | 46m. |
| " 8 | 7h. 15m. to 8h. P. M. =45 " | 1 | E. | 15 |
| " " | 8h. to 9h. P. M. =60 " | 1 | E. | 25 |
| " " | 8h. 15m. to 9h. P. M. =45 " | 1 | W. | 19 |
| " 11 | 8h. 45m. to 10h. P. M. =75 " | 1 | E. | 18 |
| " 12 | 6h. to 7h. P. M. =60 " | 1 | E. | 6 |
| " " | 8h. to 9h. P. M. =60 " | 1 | E. | 12 |
| " 13 | 0h. 45m. to 1h. 30m. A. M. =45 " | 1 |  | 10 |
| " 15 | 6h. to 7h. P. M. =60 " | 1 | E. | 2 |
| " " | 6h. 25m. to 6h. 40m. P. M. =15 " | 1 | W. | 0 |
| " " | 8h. to 9h. 15m. P. M. =75 " | 2 | E. & W. | 3 & 4 |

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* The "meteoric shower" of November, 1838, came chiefly on the morning of the 14th. According to observations made at Middlebury, Vt., and *published in* "The People's Press," by Prof. A. C. Twining, meteors were visible that morning from 4h. to 6h. in the whole heavens, at the rate of 105 per hour; and for a short time the next morning, they were nearly as numerous.

During the above observations the sky was sufficiently clear. Where *m* is annexed to the number seen, allowance must be made for the presence of the moon 5½ or 6½ days past the full. This table shows, that a season of meteoric abundance extended from the 6th to the 11th (at least,) and that it came to its maximum early on the evening of the 7th. During the evenings of the 6th and 7th, shooting stars were so frequent and brilliant, that they attracted the attention of persons abroad in different parts of the city. Being then ignorant as to the period of the night at which the display of Dec. 6, 1798, occurred, and having fallen in rather too hastily with the common conclusion, that *meteors are always most abundant between midnight and morning*, my arrangements were made chiefly for a *morning* watch. The appearances were consequently not so well observed as they would have been, but for a reliance on this premature generalization. On the evening of the 6th, meteors were not much less numerous than on the evening of the 7th, and they *did not increase in number after midnight.*[*] Professor Olmsted informs me that on the evening of the 7th, from 6½ to 8 P. M., he, with two of his sons, (F. A. Olmsted, and D. Olmsted, Jr.,) without very close attention, and in much less than the whole heavens, counted meteors at the rate of at least 100 an hour. He remarked that at 8 they were becoming less frequent. From 8 to 9, Mr. Haile and myself observed *ninety three*, and we probably saw not more than half the whole visible number; for, although a single observer can see large meteors throughout *half* the hemisphere, yet he can not detect all the smaller ones, (which are commonly the majority,) throughout more than an *eighth part* of the hemisphere. The meteors slightly diminished in number, as the evening advanced; but much to our regret, we were prevented, after about 11 P. M., by an overclouded sky, from determining the rate of diminution, or the general progress of the phenomenon. On the morning of the 8th, Mr. Haile watched from 4¼h. to 5¼h. (about a sixth of the hemisphere, in the N. W. being nearly clear,) and saw *five* meteors.

The meteors of the 6th and 7th were not unlike those of ordinary times:—many of them were large and splendid fire-balls, and attended with trains. On both evenings, (before 11 P. M.) most of the meteors appeared, (as all the observers agreed,) to radiate from a spot not far from Cassiopeia; or perhaps, more nearly, from the vicinity of the cluster in the sword of Perseus. The radiant, however, could not well be fixed, within three or four degrees. So far as it could be determined, this spot was, up to midnight, either stationary among the stars, or moved westward almost as rapidly as they did. After midnight of the night of the 6th—7th, the meteors appeared not to present any common center of radiation.

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[*] The coincidence in this respect between the meteors of Dec. 6, 1798, and those of Dec. 6 and 7, 1838, is obvious.

## II. *Observations in other places.*

1. At *Middletown, Ct.*, on the evening of the 7th, Prof. A. W. Smith, with Messrs. Knox and Rice, saw in the eastern sky, between 10h. and 11h., *seventy eight* meteors: one of the observers being absent half an hour. They stood mostly on the east side of the University building, and but little more than half the sky was under review. Prof. S. saw 20 meteors between 8h. and 9h. Most appeared to radiate "from the zenith." The sky was overcast at 11h.

2. At *Geneva, N. Y.*, Mr. Azariah Smith, Jr. undertook observations in company with Mr. M. M. Bagg. Being occupied in the evening, their attention was directed chiefly to morning observations, but a clouded sky interfered on the mornings of both the 6th and 7th. Early on the evening of the 6th, Mr. S. in a short walk, noticed meteors at the rate of one per minute, but his engagements did not permit any observations until after 9, when the sky was partially cloudy, and not long after almost wholly overcast. From 9h. and 10h. he saw between and behind the floating clouds, only 3 or 4 meteors. Mr. S. remarks, "so far as can be determined by the few observations I made in these unfavorable circumstances, I should judge that the radiant point was near to, but S. of, Cassiopeia, and perhaps a few degrees E. of that.—I cannot entertain the least doubt but that there was an unusual display about the 6th and 7th inst., for on mornings and evenings previous, I saw nothing similar in kind or number to those of the evening of the 6th. I learn from some friends of mine, who knew nothing of the anticipations with regard to this phenomenon, that on being out during the evening of the 6th, they saw so many falling stars that they concluded to

sit up all night and see if there would not be a shower, but under the unfavorable circumstances their hearts failed them."

3. At *Hudson, Ohio*, clouded skies prevented observation.

4. From *Savannah, Ga.*, Mr. T. R. Dutton writes: "The entire night of the 5th was rainy. On the night of the 6th I made occasional observations from my window, (without seeing more than 2 or 3 meteors,) between 11h. and 2h. 30m. when I went into the open air.* From 2h. 30m. to 3, I saw 5 meteors, and from 3h. 15m. to 3h. 30m., none. The sky was partly covered with broken clouds, yet not enough so to obscure more than a third of the meteors visible; but soon after it was entirely overcast. On the evening of the 7th, I made occasional observations as before, until 2h. 55m., when I went into the open air. During 45 minutes I saw 11 meteors, 4 or 5 of which had trains. The sky was partly covered with thin cirrous clouds,—the western half, however, afforded a clear field of view. On the night of the 8th, I watched from 3h. 25m. to 3h. 55m. and saw eight meteors."

### *General Remarks.*

From the observations made here, it may safely be concluded that for four or five hours, on the evening of the 7th of December, 1838, shooting stars appeared at the rate of from 125 to 175 per hour. If we compare this with the average which I had previously fixed upon, for this season of the night, (viz. 25 per hour) it results, that on this occasion meteors were about *six* times as numerous as usual. If we adopt M. Quetelet's *general average*, of 16 per hour, the number was about *nine* times the mean. More extensive observations will doubtless change both these averages. No one can however doubt that the displays of the evenings of the 6th and 7th were quite unusual. For several days after this period, meteors were rather more numerous than usual, but by the 15th, the *meteoric season* appeared to be altogether over.

It is evident that the position of the *radiant* was at a great remove from that point in the heavens, towards which the earth was at the time tending; and it is worthy of notice, that in this respect, and partially in another, the December display resembles that of August. In the November "shower," the radiant is very nearly in the ecliptic. The grand display of April 20, 1803,* agreed with all the November displays, in this, that it appeared chiefly after midnight, but where the radiant then was, no man can tell us.

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* Shooting stars *must always* be watched in the open air: observations through a window can not be trusted.

There are other seasons in the year at which meteors may possibly be found unusually numerous: some of these are,—Oct. 8—15, June 10—20, Jan. 2, Feb. 15, July 28, Sept. 11, Nov. 8. It is not worth while here to give the details of the various accounts from which these dates are taken. They are generally vague, and mostly reported by those who had no just ideas concerning the average number of meteors. Of this list, the two first appear the most worthy of attention. Observations should however be made at all these seasons, and indeed at all possible times; for it is alike important that we should ascertain these seasons in which meteors are uncommonly rare, and those in which they are uncommonly abundant.†

In order to obtain all the data necessary for the formation of a theory of shooting stars, we must have observations in various places and at various times, which will show us not only their numbers and their apparent motions, but also their *true* velocities, directions, and distances. This is a part of the subject which demands vastly more labor and skill, than the other. It is far from certain, that the results obtained by Benzenberg,‡ Brandes, Quetelet, and their associates, will apply with general accuracy to parts of the year, or of the night, different from those in which they were obtained, and it is therefore much to be desired, that similar connected observations should be made in all regions of the earth, both morning and evening. It may be found, that a constant difference exists in the directions and velocities of the meteors which occur during the August season, and of those of the displays which occur in November, December, and April.

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* This shower ought to be re-discovered, and there can be little doubt that if diligent observation should be made at this season of the year, in all quarters of the globe, some evidence of its return might be detected.

† If any person who has the opportunity, will consult the *Ephemerides Societatis Meteorologicæ Palatinæ*, (5 tom. 4to. Manheim., 1785 ?) and publish anew all the observations on luminous meteors contained in that valuable series, he will do a service to science. The work is inaccessible here, and seems to be nearly forgotten every where.

‡ This gentleman, a Professor at Düsseldorf on the Rhine, divides with Prof. Brandes of Leipsic, (who died in May, 1834,) the honor of having first made (viz. in Dec. 1798) definite observations on the distances, velocities and paths of shooting stars. The 1st livr. of the 3d series of Quetelet's *Corresp. Math. et Phys.* 8vo, Bruxelles, Août, 1837, (the only one I have seen,) contains a very interesting letter on this subject from Benzenberg; and also a valuable paper by Quetelet, giving the details of the simultaneous observations made by himself and his associates, on five nights, between 9 and 12, P. M., in June and July, 1824, together with three methods of calculation applicable to these observations.

Enough appears to be already known to establish the proposition, that shooting stars are small bodies of various sizes, materials and densities, revolving around the sun, and luminous in consequence of the heat excited by their casual passage through our atmosphere.* They have not inappropriately been termed by M. Coquerel, *microscopic planets.* So far as we know, they have the same astronomical relations as the larger luminous meteors called *fire-balls*, *bolides*, *meteorites*, &c. They are encountered by the earth's atmosphere probably every hour in the year, but in much greater numbers at certain parts of the earth's orbit, than at others. The distribution of these bodies throughout the solar system can not yet be determined. The majority of them probably move in groups, and may be supposed to constitute one or more broad zones or rings, in some parts of which meteors are exceedingly numerous. When, at the return of certain periods,† the earth traverses these dense parts, great meteoric showers occur, like those of the years 686, 29, 25, B. C., and those of A. D. 532, 558, 750, 765, 901, 935, 1095, 1096, 1122, 1799, 1803, 1832, 1833. It may be supposed that in other years, the earth passes through a part where the meteors are less numerous, and then only a *sprinkling* of meteors is seen. Whether there are more zones than one, and if so, how they are situated, are problems which will probably long remain unsolved. Whether these meteors are the fragments of the supposed exploded planet, of which the four *asteroids* may have formed a part,‡ or whether they were originally independent bodies, will perhaps be determined at a much later day. These little bodies doubtless reflect the sun's light, but in consequence of their minuteness, they are rarely, if ever, seen in this way. There is however room to hope, that they may be occasionally detected by powerful telescopes, while moving in their celestial paths, across the sun's disk. The discovery by Pastorff, in this mode (Bib. Univ. de Genève, 1835, t. 58, p. 434) of two or more new asteroids, and the previous observations of Gautier and Messier, induce the belief, that similar investigations hereafter will reveal important results.

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* This opinion is far from being new. It is found in substance in Plutarch's Life of Lysander, and although it has never been very generally received, yet it has always had some supporters. It was ably illustrated and defended by the celebrated Chladni; and it is maintained by many at the present day.

† The cycle of the November shower seems to be, without much doubt, 33 or 34 years: that of the April shower is perhaps about 27 years.

‡ This hypothesis, advanced by Prof. Wildt, is quoted with a partial approval by the distinguished Olbers, in a valuable paper on shooting stars in Schumacher's Jahrbuch für 1837. It is remarkable, that a very similar idea is found in De Mezeray's Hist. de France, (4to, Amst. 1755, tom. ii, p. 156,) in an account of the meteoric shower of 1096; his words are, "On vit durant plusieurs nuits pleuvoir des Etoiles, par intervales, mais si dru et menu, qu'on eût dit que c'étoient des *bluettes du débris des orbes celestes*."

It has been conjectured, that shooting stars proceed from the luminous appearance, long known and little understood, called the *Zodiacal Light.* It may therefore not be irrelevant to advert to the fact, that the earth is in a situation more favorable for collision with this body, early in December, than in the middle of November.

An account of the progress of discovery concerning the meteoric season of August, together with some additional observations on the meteors of August 9—11, 1838, are postponed for want of room.

New Haven, December 24, 1838.

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## Art. XX.—*On the Meteoric Shower of November,* 1838; by Denison Olmsted, Professor of Natural Philosophy and Astronomy, in Yale College.

Efficient arrangements were made at Yale College, by a number of young gentlemen of the senior class, in conjunction with myself, to watch the heavens on the night of the 12th and 13th November, with the view of ascertaining whether the meteoric shower which has occurred, to a greater or less extent, at this date, for several years past, would be repeated the present year. The night was unfavorable for observation; still, occasional glimpses of clear sky, were seen at different times of the night, sufficient to have recognized the phenomenon, had it occurred in a manner corresponding to the exhibitions of former years. Although a few meteors were seen, yet we adopted the conclusion, that, at this place, *there was no extraordinary appearance of shooting stars on the morning of the* 13*th November.* On the following morning, Nov. 14, shooting stars were more frequent; but we did not feel authorized from our observations, to pronounce that the exhibition was so remarkable as to be properly denominated a "meteoric shower." I find, however, that some of my friends and correspondents abroad were more fortunate. The most decisive communications which I have seen on this subject, are from Professor A. C. Twining of Middlebury College, Vermont, and from Mr. E. Fitch, Professor of Mathematics in the United States Navy, who was then on a cruise in the Gulf of Mexico.

According to the statements of Professor Twining, published in a Middlebury paper, a vigilant watch was maintained by himself and nine of his pupils, from the 10th to the 15th of November. The results of their observations were as follows:

Nov. 10.—From 3 to 6 A. M., the whole number of shooting stars observed was 70, of which 40 were from the constellation Leo, within the bend of the sickle. Eight were attended with trains. The observations on the two following mornings presented nothing differing much from those of the 10th. The night of the 13th was cloudy, and no observations could be obtained.

Nov. 14th.—The morning was mostly clear from 4 to 6 o'clock, which was the period of observation. The phenomena differed remarkably from those of the preceding mornings, both as respects the number of falling stars, and their appearance. A large portion of the whole were attended by trains. The number was more than three times as great as on either of the previous mornings, being at the rate of 105 per hour. One meteor of remarkable size and splendor, shot from the common radiant, to the Great Bear, where it exploded, leaving a bright streak about two degrees long, which turned slowly to a vertical position, then expanded into a cloud which continued visible nine minutes, and moved in a westerly and descending direction about seven degrees before it became invisible. The flash of this meteor was seen by observers looking in the opposite direction, to illuminate the earth's surface like a faint flash of lightning. The spot where the explosion took place, was in Right Ascension 182°, and Declination 46½°. Of all the meteors observed on this occasion, nine out of ten had their courses in a direction from a common radiant, situated in the upper part of the bend of the sickle in Leo.

On the morning of the 15th, shooting stars were very frequent, but less so, on an average, than on the preceding morning, and far less regular with regard to a common source, or radiant.

By a letter from Professor Fitch, dated from the Gulf of Mexico, I learn that he watched for shooting stars on the morning of the 13th November, but considered the number and size of such as fell, as not above the average in that latitude. On the morning of the 14th, from 3 to 4, he counted 40 shooting stars; and from 4 to 5, he counted 45. He thinks the number obscured by clouds probably one fourth of the whole. The point of radiation was 2° E. S. E. of gamma Leonis. It will be seen that these statements agree remarkably well with those of Professor Twining, although probably the numbers reported by Mr. Fitch ought to be considerably increased, in consequence of there being at that station but a single observer.

The unusual frequency of the meteors seen on this occasion; the precision with which they conformed in their courses to what has heretofore been observed at the same date; the occasional brilliancy of individual meteors; the number and brightness of the attendant trains; and the time of the morning when the display reached its maximum; these circumstances afford, in connexion, conclusive evidence of the identity of this exhibition with those heretofore observed on this anniversary, although, according to anticipations expressed several times in this Journal, *the phenomenon is repeated on a constantly diminishing scale.*

As several of the most eminent astronomers of Europe, are now occupying themselves with the "Theory of Shooting Stars," (which some of our own astronomers have supposed *beneath their attention,*) we may hope that, before long, the difficulties which attend the explanation of the "origin of shooting *stars*" will be completely removed, and we shall know whether to regard them as atmospheric concretions, or as visitants from another sphere.

P. S.—*Extract of a Letter from* Mr. Willis Gaylord, *dated Otisco, New York, Nov.* 22, 1838.—A brilliant flight of meteors was seen from this place on the morning of the 14th instant. The nights of the 12th and 13th were cloudy, rendering observation impracticable. My attention was called to the frequent occurrence of meteors a few minutes before 6 o'clock; and from that time until the moon and the opening day caused their disappearance, there was an *almost* continued succession of them. I have never, at any time, seen so many, in so small a space of time, except in the great meteoric shower of November, a few years since. The point of radiation was a few degrees S. E. of the zenith, and *every meteor had the same direction,* viz. southeast. The trains of some were brilliant, but in general they disappeared quickly, though some continued their flight across a quarter of the heavens.

## ART. XXI.—*Communication respecting Fossil and Recent Infusoria made to the British Association at Newcastle.* By Prof. EHRENBERG.*

To the Editors of the Annals of Natural History.

*Gentlemen,*—You will much oblige me by inserting the subjoined notice, which has been occasioned by the erroneous report in the Athenæum of the statement made by me at the late Meeting of the British Association in Newcastle, in the section of botany and zoölogy, which statements, so far as I can recollect, were to the following import:

For the purpose of physiological inquiries I have occupied myself with the investigation of microscopic organized beings, not only in Europe, but also upon several voyages for several years in other quarters of the globe. The results of my observations had been hitherto scattered in single memoirs, published in the Acts of the Royal Academy of Berlin. Within these few weeks, however, my large work on this subject has been completed,† which consists of a thick folio volume of text and 64 folio copper plates, in which I have endeavored to bring together the whole of our present knowledge of microscopic beings, with their history in as complete a state as possible. This book, which I had the pleasure of laying before the section, is not (as stated) the first volume of a work, but complete and entire in itself, and is now in the booksellers' hands. It contains drawings of all the 722 species observed by me up to 1835. It is however merely a first essay on this highly interesting and at present inexhaustible subject. I then in a few words directed the attention of the section to the importance of the observation of microscopic beings, as a highly influential zoölogico-botanical subject, and exhibited earths which were entirely formed of the shields of some Infusoria. I mentioned the eatable infusorial earth from Lillhaggsjön in Sweden, from Finland, and from Kliecken near Dessau, where they occur in great natural layers; I stated that the greatest layer hitherto discovered was above 28 feet in thickness, near Lunebourg; that however similar layers have already been found in Africa, Asia, and the South Sea Islands. At the same time I noticed that I had succeeded in artificially preparing from still existing Infusoria very considerable quantities of earth. I exhibited a large glass full of such artificial siliceous earth, in which the microscope, however, still evidently and distinctly discovers all the forms of the Infusoria constituting it, pounds and tons of which earth may easily be prepared. I mentioned in few words the still existing controversy between botanists and zoölogists, both of whom would class in their catalogues these microscopic living forms; and I briefly noticed the reasons given in detail in my work for each opinion, deciding myself in favor of their being animals.

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* From the Annals of Natural History, No. 3, p. 121, London.

† Uber Infusionsthierchen, mit einem Atlas von vier und sechzig Kupfertafeln. Von Christian Gottfried Ehrenberg.

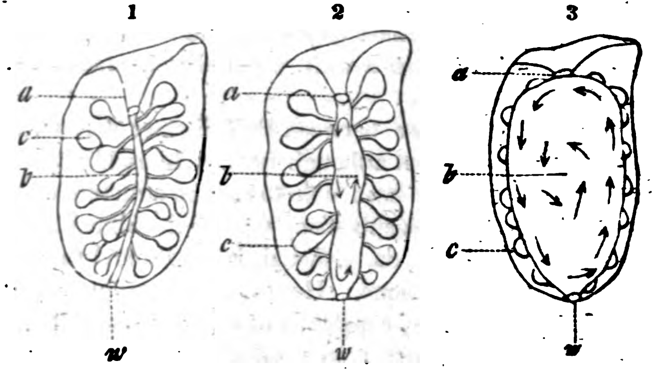
I also said a few words on the luminosity of the sea, which subject in part stands in immediate connection with these microscopic animals, it being regarded an act of animal life; and I invited attention to the fact that the luminosity in Infusoria and Annulata is an evident voluntary production of sparks, so that in the latter there originates a light apparently continuous and tranquil to the naked eye, from numerous microscopic sparks following each other in quick succession. The analogy with electrical phenomena is very close, and it is especially worthy of attention, that evidently the smallest animals give the largest sparks, in proportion to the size of their body, and consequently very probably produce the greatest electrical tension.

I then mentioned the curious formation of double gems in *Closterium* and in the *Confervæ conjugatæ*, which is figured in the plates of the family of the *Closterinæ*, and I concluded with a remark on the astonishing great fertility or capacity of increase of microscopic animals, according to which an imperceptible corpuscle can become in four days 170 billions, or as many single individual animalcules as contained in 2 cubic feet of the stone from the polishing slate of Bilin. This increase takes place by voluntary division; and this is the character which separates animals from plants. It is true, that the gemmation in plants, especially in very simple cells, is at times very similar to the division in animals, but this relates to the form, not the formation. A vegetable cell apparently capable of self division always became one, or contemporaneously many exterior warts (gems) without any change in its interior. An animal which is capable of division first doubles the inner organs, and subsequently decreases exteriorly in size. Self division proceeds from the interior towards the exterior, from the center to the periphery; gemmation, which also occurs in animals, proceeds from the exterior towards the interior, and forms first a wart, which then gradually becomes organized.

A discussion now arose between Prof. Rymer Jones and me. Prof. Jones observed, that although he had himself taken great pains, yet he had never been able to see the structure described by me of the interior organization, viz. of the alimentary canal of the polygastric Infusoria, although he had found the external forms to be exactly the same. He had not been able to discover any trace of an alimentary canal, and in *Paramæcium Aurelia* and other species he had observed a circular motion of the inner cells which could not agree with the formation I had described. I answered him, that such discussions then only could lead to a result when they do not merge into general but enter into special cases. The mass of relations of organization, which after many years of observation have been gradually established, could not be brought into question by a single doubtful fact. The perfect organization of the wheel animalcules had been established beyond all question. With regard to *Paramæcium Aurelia*, this is one of those forms unfavorable to such observations; and it had been expressly observed by me that I myself had not been able to recognize the alimentary canal in all species of the various genera; but on the other hand it was quite evident in a very considerable number of species and genera. I stated that in my present work this subject had been treated of in detail, and that those forms in which the relations are perfectly evident have been purposely enumerated. Some of these forms I then exhibited in the drawings, and concluded with the remark that the circular motion observed by Prof. Jones had already been treated of by others, (for instance, Dr. Foeke,) and had naturally been frequently observed by myself. The great contractibility of the body of the animalcule was, to less practiced observers, frequently a cause of enigmatical phenomena, of which continued patient observation of the object would gradually bring the explanation. Thus, at times, the intestinal canal of the animalcule extends at the expense of the ventral sacs so far, that it occupies the whole space of the body, and then the devoured substances, very similar to the ventral sacs, circulate in the whole body. Yours, &c.

EHRENBERG.

London, Sept. 15, 1838.



Ideal figures of *Loxodes Bursaria* in various states of the extension of the alimentary canal, and its inner circular motion, not of the ventral sacs, but of the contents of the sacs voided into the canal *a* the mouth, *b* the alimentary canal, *c* ventral sacs, *w* canal aperture.

## MISCELLANIES.

1. *Dr.* TORREY'S[*] *Experiments on the Condensation of Carbonic, Sulphurous, and Chloro-chromic Acid Gases.*—We have been, from time to time, informed by letters from Prof. John Torrey, of New York, of his progress in the condensation of gases, and we now take the liberty to give some few citations from his letters, although not intended for publication, satisfied that Dr. Mitchell, who has given us such fine results, will be glad to see them, and trusting that Dr. Torrey will pardon the use made of his private communications.

*March* 5, 1837—It it stated by Prof. T. that a few days before he had prepared several tubes of liquid carbonic acid at Princeton, New Jersey.

*April* 11—He writes again, that although he had been unable to get a mechanic to construct an apparatus for condensing carbonic acid, he had made many experiments on the subject in tubes of glass, and with entire success. He says, that only a single accident occurred, which however did no serious injury. Having a fine quantity of the condensed liquid in a sealed tube, but wishing to aid the generation of carbonic acid by heat, he plunged one end of the tube into hot water in a tumbler, while the other end was enclosed in a freezing mixture, when it burst, shattering the tumbler, &c., but the water greatly abated the force of the blow. The explosion was caused by the formation of crystallized sulphate of ammonia, from the action of the sulphuric acid upon the carbonate of ammonia, (the materials used to afford the gas,) which sublimed and choked the tube, about half way up, so that the carbonic acid gas that was evolved had not the benefit of the refrigerating process above, and its elasticity was at least doubled by the heat, being equivalent to seventy six atmospheres (=1140 pounds on the square inch); the wonder is, therefore, that the courageous experimenter sustained no other inconvenience than from a little acid thrown in his face.

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[*] See Dr. Mitchell's Experiments, p. 346. Also at p. 301, Mr. R. Addams's remarks on the same subject.—EDS.

*May* 13, 1837—Dr. Torrey forwarded to me a strong tube containing a fine quantity of the liquid carbonic acid which spontaneously crystallizes in beautiful snowy crystals during freezing cold weather, while a portion remains fluid, and thus I have the pleasure of exhibiting to my chemical class the aeriform, the liquid, and the crystallized carbonic acid, all in the same tube. This day, Dec. 27, 1838, it is in that condition.

Dr. Torrey was early successful in condensing the sulphurous acid and the chloro-chromic acid. He mentions in a letter dated Nov. 9, 1835—

"The freezing of water by the latter, is a beautiful class experiment. Some ice-cold water is placed in a large watch glass or bottom of a flask; the tube containing the acid is cooled in a freezing mixture of snow and salt, (the temperature of which should be full 0° F.)—then with a small fine file rub off the extremity of the tube, so as to make the finest possible orifice; next seize the flask with a pair of forceps and invert it, or hold it obliquely downward over the glass of water. A fine stream of the acid will rush out, and falling on the water will congeal it into a spongy ice. It is unnecessary to say, that the experiment should be conducted under a hood to carry off the offensive smell of the sulphurous acid."

With respect to chloro-chromic acid he confirms Dr. Thomson's statement, that perfectly dry phosphorus is not inflamed by it; it may be even melted in the liquid acid, but if moist in the slightest degree, it will burn with a loud explosion, requiring particular precautions.—SENIOR ED.

### 2. *Critical Interpretation of bara and asah, in a letter from Dr.* NOAH WEBSTER *to the Rev. William Buckland, Oxford, England.*

*Rev. Sir*—I am reading your treatise on Geology with great pleasure, and, I hope, not without instruction.

In the second chapter of your treatise on Geology, a part of the Bridgewater Collection, you have advanced the doctrine that the matter of this globe was created long before it was reduced to its present form or state, for the residence of the present race of men. This doctrine supposes that the first verse in Genesis refers to the first creation of the matter of the globe, and of the celestial orbs; and that between that event and the creation of man, an indefinite period of long duration elapsed before the reduction of the earth to its present form.

Long before your treatise on Geology was written, and anterior to the modern discoveries of the remains of animals and plants in the different formations of the crust of the earth, I had conceived the same opinion. I could hardly express my opinions better than Bishop Gleig has expressed them in a note in page 32 of your book, Philadelphia edition.

My object now is merely to offer a few remarks on the Hebrew words *bara* and *asah*, which are used to express *creation* and *making*. I suppose that lexicographers and commentators have mistaken the primary signification of *bara*. Gesenius supposes the primary sense to be *to cut, cut out, to carve*, or *to form by cutting or carving*, from the notion of *breaking, cutting*, or *separating*, inherent in the radical syllable בר.

But this is probably a mistake, which shows how imperfectly the most eminent scholars understand the order in which the various uses of words are derived from a radical signification. If the primary sense were to *cut*, or *carve*, the sense of *being born* or *producing young*, could not be deduced from it. Yet Gesenius himself thus interprets the word, in Ezek. 21 : 30, 28 : 13; Ps. 104 : 30.

The primary sense of the word is probably *to separate* in some form or other, and *cutting* may be deduced from that sense. But in expressing *creation*, the sense is to *produce*, to *drive out*, or *send forth*. *Creation* was a *producing* to light or to existence in a visible form. Thus the apostle expresses the fact, as Macknight renders the original words, and as I should render them: "so that the things which are seen were not made of things which appeared;" that is of things previously formed and visible. Heb. 11 : 3. I am the more inclined to this opinion, because I believe the word *bara* is our English word *bear*, or of the same family, coinciding with the sense in which we use it for the production of infants and of births.

The word *asah* seems rather to denote the *act* or *process* of *shaping* and *fitting for use*, by giving due form to a thing. And I would suggest it as worthy of consideration, whether the sense of the passage, Gen. 11 : 3, in which both of these words are used, is not this—Because that in it he had rested from all his works which God *produced for formation*; created to be reduced to a form for use, or for its intended purposes.

For the great variety of uses or application of this Hebrew root, see the Introduction to my Quarto Dictionary.

These suggestions are offered with some diffidence, by

Your obedient servant, N. Webster.

New Haven, Connecticut, United States, Nov. 16, 1838.

3. *Notice of the Height of Mountains in North Carolina, from Prof.* E. Mitchell, of Chapel Hill University. (Taken from the Raleigh Register of Nov. 3, 1835, and forwarded by Prof. M.)

The younger Michaux, on his way from the Valley of the Mississippi, in the fall of 1802, passed through the counties of Yancy and Burke, and in the small volume, containing an account of his travels, that was published soon after his return to Paris, the opinion is expressed, that in these counties, the Alleghany Mountains attain their greatest elevation. He mentions, in evidence that this belief is well founded, that his father found trees and plants growing upon them which he did not meet with again before reaching Canada.

The geology of these counties has some peculiar features. They were visited during the last summer, for the purpose of tracing the boundaries of their rock formations, and along with other collateral objects, provision was made for measuring the heights of their principal mountains, with their bearings and distances from each other. Prof. Mitchell in a letter to the editor, dated University of North Carolina, May 12, 1838, remarks that the results transmitted were obtained by himself. He adds—

"In their general accuracy I placed a confidence at the time which has been increased by the publication of the Report of the Surveys made by the engineers employed by the Charleston and Louisville Rail Road Company. For the height of Mount Washington I trusted to Worcester as the best authority within my reach. The difference in elevation between the northern and southern mountains is probably not considerable; in point of beauty there is in some instances a decided superiority on the side of the latter. Mount Washington, according to his measurement, is not so high as the highest peak of the Black Mountain."

One barometer he observes was stationed at Morganton, and a record kept of its movements by Mr. Pearson of that place. This served as a standard. The observations made at the same time (nearly,) upon the tops of the mountains and at Morganton, furnished the data for calculating their elevations above that village, and the mean of ten observations, on successive days, gave what is probably a near approximation to the height of Morganton above the level of the sea—nine hundred and sixty eight feet. Deducting from this the descent to the bed of the Catawba, there remains only about eight hundred feet of fall between the ford leading over Linville and the sea.

North of the point where the James River leaves the mountains, the first high ridge of the Alleghanies is called the Blue Ridge. In North Carolina, this name is applied to the range that separates the eastern and western waters. This is commonly the first high mountain, but not always. The *Table Mountain,* which forms so fine and striking a feature in the scenery about Morganton, is not a part of the Blue Ridge, but a spur or outlier. It seems, when seen from Morganton, to be a round tower; rising perpendicularly from the summit of the first range of the Alleghanies. It is, in fact, a narrow ridge, affording a very fine prospect of the fertile valley of the Catawba and its tributaries on the southeast and east, and of nature in her wildest dress where the Linville pours over the rocks along a deep ravine, wholly untenanted and uncultivated, and of a vast extent of mountain peaks and ranges on the northeast. Its top is two thousand four hundred and fifty three feet above Morganton, and a little more than fifteen miles distant in a right line.

The Grandfather, seventeen miles from the Table, and twenty eight from Morganton, has hitherto been generally supposed the highest mountain in North Carolina. But this proves to be a mistake, as may be seen in the following table. There is a mountain not far off called the Grandmother; from being crowned with the balsam of fir it is conjectured that the elevation may be twenty six hundred feet.

The *Roan Mountain* is fifteen miles from the Grandfather, and thirty five northwest from Morganton, lying directly over or beyond the Hawksbill. It touches the Tennessee line, but the highest peaks are in North Carolina. This is the easiest of access, the most beautiful, and will best repay the labor of ascending it of all our high mountains. With the exception of a body of rocks looking like the ruins of an old castle, near its southwestern extremity, the top of the Roan may be described as a vast meadow, without a tree to obstruct the prospect; where a person may gallop his horse for a mile or two, with Carolina at his feet on one side, and Tennessee on the other, and a green ocean of mountains raised into tremendous billows immediately about him. It is the elysium of a southern botanist, as a number of plants are found growing in this cold and humid atmosphere, which are not seen again till we have gone some hundreds of miles farther north. It is the pasture ground for the young horses of the whole country about it during the summer. We found the strawberry here in the greatest abundance and of the finest quality, in regard to both size and flavor, on the 30th of July.

The *Black Mountain* is a long ridge, at a medium distance of about thirty miles from Morganton. It has some peaks of greater elevation than any point that has hitherto been measured in North America, east of the Rocky Mountains, and is believed to be the highest mountain in the United States. The Black Mountain cost nearly a week's labor in fixing upon the peak to be measured and the measurement. For the sake of comparison the following heights are given. The first five are copied from Worcester's Gazetteer:

| | |
|---|---|
| Mount Washington in New Hampshire, hitherto accounted the highest mountain in the United States—highest peak, | 6,234 |
| Mansfield Mountain, Vermont, | 4,279 |
| Saddle Mountain, Massachusetts, | 4,000 |
| Round Top, highest of the Catskills, | 3,804 |

| | |
|---|---|
| Peaks of Otter, Virginia, | 3,955 |
| Table Mountain, Burke, North Carolina, | 3,421 |
| Grandfather, | 5,556 |
| Yeates' Knob, | 5,895 |
| Black, at Thomas Young's, | 5,946 |
| Roan, | 6,038 |
| Highest peak of the Black, | 6,476 |

There are other high mountains at no great distance from those that were measured, as the Bald Mountain in the western part of Yancy, and the White Top in Virginia, which are nearly if not quite as high as the Roan. In the southeastern part of Haywood county, near the South Carolina line, there is a tremendous pile, and between the counties of Haywood and Macon and the State of Tennessee, the Unikee Mountain swells to a great elevation. But these appear to the eye to be lower than the Black.

The Pilot Mountain, which has heretofore enjoyed great celebrity, is much lower than several others. The ascent of the Black Mountain is very difficult on account of the thick laurels which are so closely set, and their strong branches so interwoven, that a path cannot be forced by pushing them aside; and the hunters have no method of advancing, when they happen to fall in with the worst of them, but that of crawling along their tops. The bear, in passing up and down the mountain, finds it wisest to keep the ridges, and trampling down the young laurels as they spring up, breaking the limbs from the old ones and pushing them aside, he forms at last a sort of burrow above ground, through this bed of vegetation, along which he passes without difficulty. This is a bear trail. The top is covered with the balsam fir, from the dark and sombre shade of whose foliage it doubtless received the name of the Black Mountain. The growth of the tree is such on these high summits, that it is easy to climb to the top and taking hold of the highest branch look abroad upon the prospect. At the time of our visit, the mountain was enveloped in mist, which prevented our seeing more than a couple of hundred yards, and we were so uncomfortable from cold, that some of the company urged a return with the least possible delay, and this when it was clear weather, at a small distance below the ridge and the thermometer at 80°.

The temperature of a few wells and springs is subjoined. The finest iced water is a vapid drink, in comparison with the pure element that gushes from the sides of these western mountains.

| | |
|---|---|
| Wells on Chapel Hill, Oct. 17, | 59° |
| Well in Lincolnton, July 16, | 61° |
| " Morganton, July 16, | 58° |
| Spring in Keller's Field, | 58° |
| " Daniel Moore's Globe Settlement, | 57° |
| " James Riddle's, | 54° |

| | |
|---|---|
| Spring near the top of the Grandfather, . . | 53° |
| " Ascent of the Roan, . . . | 52° |
| " North side of the Black Mountain, . . | 50° |
| " Another, same Mountain, . . . | 48° |

4. *Fossil Shells and Bones.*—A correspondent writes from Wilmington Island, near Savannah, July 16, 1838,—Wilmington island is situated in the Savannah river eight miles from the sea, and would appear, though surrounded by salt water, to be a part of the delta of the river, were it not for the vast beds of shells (principally oysters) which are found upon it. These beds extend through all the islands in this vicinity, and although attributed by some to the aborigines, are evidently the deposits of the ocean, as they are found in layers of uniform thickness wherever they have not been disturbed. Under such circumstances they are found about three or four feet from the surface. You heard, I suppose, of the discovery of fossil bones made in this State last spring while digging the canal near Brunswick. I endeavored to lay hands on some of them, but found that they were to be sent to the Nat. Hist. Soc. of Boston. They were the only bones ever found in this State except those of the megatherium. They were at first supposed to belong to the mastodon. Dr. S., the gentleman with whom I reside, has in his possession some of the bones of the megatherium. T. R. D.

### 5. *Auroral Arch in Vermont.—Eclipse.*

Burlington, Vermont, 20th November, 1838.

To the Editors.—*Gentlemen*—Again has the same region, described in your 33d Vol., p. 212, presented a similar phenomenon, and for the reasons there given, and with the view of obtaining a certain parallax in order to ascertain the distance of these wonderful phenomena, I shall describe this also to you.

On the evening of the 7th of September I was called out by a friend to look at a remarkable light. It extended to within 10° or 15° of the horizon at each extremity, passing between Alpha and Zeta Pegasi, leaving both stars just clear of its penumbra, between Beta Cygni and Beta Lyræ, enveloping both in its penumbra, and just N. of Arcturus. This was at 8h. 30m., and it continued nearly unchanged for five minutes. It then seemed disturbed on its N. edge, especially near Lyra, as if by a current moving westerly, and continually detaching small fragments, which, on their separation, immediately disappeared. At the same time, the portion between Lyra and Arcturus was greatly bent towards the south. In about 5m. more it entirely disappeared. If I can trust my recollection, it was brighter than those I saw last year. There was a very bright and active light in the north at the same time, and long afterwards, but exhibiting nothing else uncommon.

An attempt was made to obtain an observation of the late eclipse with the following result. Sun's center on the meridian by chronometer 11h. 53m. 53 sec. Eclipse began by chronometer 3h. 12m. 50 sec. Chronometer gaining 3.87 sec. per day. The end was involved in thick clouds.

Yours with high respect, JAMES DEAN.

6. *Geological Specimens from the East Indian Archipelago;* from JAS. T. DICKINSON, Miss. of the A. B. C. F. M.

Singapore, 20th March, 1838.

TO PROF. SILLIMAN.—*Dear Sir*—I send by a friend, Mr. Hope, a few geological specimens which I collected not long since during a voyage among the islands of the Indian Archipelago. The specimens are very small for convenience of transportation, and their value, if they have any, is derived only from the fact that they are from highly interesting islands, which, if I mistake not, are little known to geologists.

The Ternati specimens are most of them from the top of the mountain, 5060 feet high, and exhibit the trap rock in all stages of fusion. The mountain is a volcano, the crater of which was emitting smoke, but no flame, at the time we visited it.

The coal from Borneo was found *in situ* among the hills, and may probably be found in any quantity.

The rock of the island of Singapore is all red sandstone, so far as I know. In some places the sandstone has fragments of quartz imbedded in it.

The mountains of the Malay peninsula are granite, and so also are those of Cochin China. The islands east and south of Borneo are trap, and abound in volcanoes. Beginning, then, at the north and west, we have granite—next, proceeding towards the south and east, we find sandstone—and next, trap.

REMARK.—The specimens sent by Mr. D. fully sustain his opinions; and there are among them also very beautiful chalcedonies and agates from the hills and beach at Mindanao.—EDS.

7. *Resemblance to an Aurora.—Extract of a letter from* GEORGE GIBBS, *Esq., dated New York, Nov.* 26, 1838.—A druggist's store in Pearl street was burnt in the evening and while the air was filled with snow, (a slight fall took place during the night,) and a column of pale light shot up from the blaze as high as the zenith, (in appearance.) It was entirely distinct in color from the light of the fire or smoke, being stationary, higher, and slender like the mast of a vessel. It was to the south of where I stood and about a mile off, and was noticed by others at the time. I had no doubt of its being an artificial aurora. You will be able, perhaps, to explain it if not.

## 8. METEOROLOGICAL REGISTER FOR 1837,

Kept at Montreal, Lower Canada, in Lat. 45° 50′ N. Long. 73° 22′ W. by J. S. M'Cord, Corresponding Secretary of the Natural History Society, and Member of the Literary and Historical Society, Quebec, and Albany Institute, State of New York.

| MONTHS. | Barometer. | Thermometer. | WIND. Number of days blowing. | | | | | | | | WEATHER. Number of days each. | | | | | | Rain Gage. | Snow Gage. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | N | NE | E | SE | S | SW | W | NW | Cr. | Cy. | Rn. | Shrs. | Fog. | Snw. | | |
| January | 29.713 | 8.70 | 5.0 | 1.0 | 0.0 | 0.0 | 3.0 | 5.5 | 14.5 | 2.0 | 13.0 | 12.0 | *.75 | . . | 1.25 | 4.0 | .. | 21.55 |
| February | 29.830 | 15.78 | 6.0 | 3.0 | 0.0 | 0.0 | 6.5 | 6.0 | 3.5 | 3.0 | 6.0 | 16.5 | .5 | .25 | .5 | 4.25 | .. | 18.50 |
| March | 30.007 | 25.15 | 8.0 | 0.0 | 2.0 | 1.0 | 7.5 | 4.0 | 6.5 | 2.0 | 10.5 | 16.5 | 3.5 | . . | .. | .5 | 1.20 | 4.15 |
| April | 29.739 | 40.40 | 3.0 | 2.5 | 0.5 | 0.5 | 3.0 | 2.5 | 11.5 | 6.5 | 14.0 | 11.25 | 3.25 | . . | .. | 1.50 | 2.45 | 4.25 |
| May | 29.824 | 52.15 | 3.0 | 1.0 | 2.0 | 2.5 | 5.5 | 4.0 | 7.5 | 5.5 | 13.5 | 11.5 | 6.0 | . . | .. | .. | 2.95 | 0.30 |
| June | 29.705 | 65.55 | 8.5 | 2.0 | 1.0 | 2.0 | 3.0 | 6.5 | 6.0 | 1.0 | 10.0 | 14.5 | 3.25 | 2.25 | .. | .. | 2.00 | .. |
| July | 29.710 | 65.60 | 3.0 | 0.0 | 0.0 | 0.5 | 1.5 | 5.0 | 5.5 | 8.5 | 12.5 | 5.5 | 2.75 | 2.70 | .50 | .. ‖ | 2.00 | .. |
| August | 29.792 | 65.15 | 7.0 | 0.0 | 1.5 | 0.0 | 1.0 | 10.5 | 11.0 | 0.0 | 15.75 | 11.25 | 2.00 | 2.00 | .. | .. | .60 | .. |
| September | 29.837 | 58.30 | 2.0 | 1.0 | 0.0 | 2.5 | 3.0 | 5.0 | 13.5 | 3.0 | 15.5 | 8.5 | 5.5 | 0.5 | .. | .. | 3.05 | .. |
| October | 30.026 | 43.20 | 4.0 | 1.5 | 0.5 | 0.5 | 1.0 | 4.0 | 3.5 | 5.0 | 8.5 | 7.0 | 3.75 | .25 | ..† | .50 | 2.65 | 1.00 |
| November | 29.811 | 33.70 | 1.0 | 0.5 | 0.0 | 0.0 | 1.0 | 3.0 | 9.5 | 1.0 | 5.75 | 6.0 | 2.75 | 1.50 | ..‡ | .. | .. | 3.65 |
| December | 29.882 | 20.95 | 6.0 | 1.0 | 0.0 | 1.5 | 2.5 | 4.0 | 9.0 | 1.0 | 10.25 | 12.25 | 0.25 | . . | ..§ | 2.25 | .. | 11.10 |
| | 29.823 | 41.22 | 56.5 | 13.5 | 7.5 | 11.0 | 38.5 | 60.0 | 101.5 | 38.5 | 135.25 | 132.75 | 34.25 | 9.50 | 2.25 | 13 00 | 16.90 | 64.50 |

Mean Pressure of the Year, corrected and reduced to 32° Fahrenheit . . . . . . . . . . . 29.823
Mean Temperature of the Year, mean of Maxima and Minima by Register Thermometers . . . . . . . . . 41. 22
Maximum height of the Barometer during the year . . . . . . . . . 30.534 . (mean of yearly Maximum . . . 30.287)
Minimum . . . . . . . . . . . . . . . 28.776 . " " Minimum . . 29.313)

Range of Barometer . . . . . . . . . . . . . . 1.758

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* Drifting. † 20 days only observed. ‡ 16 days only observed. § 25 days only observed. ‖ 24 days only observed.

| | | |
|---|---|---|
| Warmest day | +90° | |
| Coldest day | —18 | |
| Range of Thermometer | 108 | |
| Number of days Clear | | 135.25 |
| " " " Cloudy | | 132.75 |
| " " " Rain | | 34.25 |
| " " " Showers | | 9.50 |
| " " " Fog | | 2.25 |
| " " " Snow | | 13.00 |
| Number of days observed | | 327.00 |
| Number of days of Westerly winds | | 200.0 |
| " " " Easterly " | | 32.0 |
| " " " North " | | 56.5 |
| " " " South " | | 28.5 |
| Number of days observed | | 327.0 |
| Mean Temperature, 1836 | | 40.43 |
| " " 1837 | | 41.22 |

| MONTHS. | BAROMETER. | | | THERMOMETER. | | |
|---|---|---|---|---|---|---|
| | Max. | Min. | Range. | Max. | Min. | Range. |
| January . . | 30.212 | 28.776 | 1.436 | + 34 | —18 | 52 |
| February . | 30.384 | 29.322 | 1.062 | + 38 | —15 | 53 |
| March . . | 30.484 | 29.268 | 1.216 | + 49 | —13 | 62 |
| April . . . | 30.112 | 29.040 | 1.072 | + 60 | + 22 | 38 |
| May . . . | 30.118 | 29.334 | ,884 | + 80 | + 20 | 60 |
| June . . . | 30.100 | 29.278 | .822 | + 90 | + 49 | 41 |
| July . . . | 30.159 | 29.501 | .658 | + 90 | + 52 | 38 |
| August . . | 30.242 | 29.431 | .816 | + 80 | + 46 | 34 |
| September . | 30.332 | 29.455 | .877 | + 81 | + 41 | 40 |
| October . . | 30.370 | 29.450 | .920 | + 68 | + 30 | 38 |
| November . | 30.400 | 28.700 | 1.700 | + 49 | + 2 | 47 |
| December . | 30.534 | 29.200 | 1.334 | + 45 | —14 | 59 |
| Means. | 30.287 | 29.313 | | | | |

SUDDEN FLUCTUATIONS IN THE BAROMETER, &c. 1837.

| Date. | Inches and parts. | Rise or fall. | In what time. | Remarks. |
|---|---|---|---|---|
| Feb. 11 . . | .460 | rise. | 12 hours. | |
| Oct. 17 to 18. | .884 | fall. | 29 hours. | Wind S. and S. W. |
| 20. | .540 | fall. | 12 hours. | " S. E. |
| Nov. 23 . . | .700 | fall. | 24 hours. | " S. W. |
| Dec. 26 to 27. | 1.018 | rise. | 24 hours. | " W. |
| 27 to 28. | .570 | fall. | 24 hours. | " W. |

Temperature of Well, Botanic Garden—31 feet deep.

| | |
|---|---|
| Sept. 1835, to August, 1836 . . | 46° Fahrenheit. |
| Sept. 1836, to August, 1837 . . | 46.2 " |

### *Storms, Phenomena, &c.*

October 18th.—Wind and rain.—17th.—Wind S.—Shifted to S. W. on 18th.—Commenced to blow hard at 11 A. M. of the 18th. Barometer fell from 9 A. M. of 17th to 2 P. M. of 18th, .884—suddenly rose to 30.168 at 9 A. M. of the 19th.

October 20th.—Wind and rain.—9 P. M. of the 19th, wind N. E.—Barometer 30.028 blowing fresh—Thermometer 37, falling. At half past 3 A. M. of 20th, wind shifted to S. E. and storm began.—Between 4 and 5 A. M. blew a gale, heavy rain in squalls—Barometer falling rapidly.—9 A. M. storm still raging—10, began to abate, and shortly after wind shifted to S. and gradually died away.—Fall of Barometer .540 in 12 hours—rain fallen half an inch.

25th.—Snow storm—from N. by W.—began 4 A. M.—snowed till 11 A. M. and then rained all day—heavy wind.

November 4th to 5th.—Gale from N. W. with snow—began 8 A. M. of 4th.

14th.—Very brilliant Aurora—commenced at 6 P. M.—at half past 8 attained its greatest splendor—magnificent crimson pencils, darting from the zenith to E. and W.

16th.—Heavy snow storm from N. E.—commenced 3 P. M.—lasted till 7 P. M.

19th.—Steady rain, set in at 10 P. M. and continued without intermission during the 20th, 21st, to 9 P. M. 22d—at which period stopped, wind N. E.—blowing fresh—Barometer 28.878.

23d, 24th, 25th.—Heavy and continued gale from S. W.—Snow on 25th.

November 30th to December 13th.—Extraordinary mild season—warm rains—navigation open—steamers plying to the 13th December inclusive.

December 21st.—Coldest day—Thermometer varying from —14 to —18 according to situation.

26th.—Extraordinary rise and fall of Barometer—

| | | |
|---|---|---|
| 9 A. M. 26th, . . | 29.516 | |
| 9 A. M. 27th, . . | 30.534 | rise 1.018 |
| 9 A. M. 28th, . . | 29.964 | fall .570 |

9. *Geological Surveys.*—Many engagements and duties have caused us to fall in arrears in regard to several valuable geological reports, particularly of New York, Maine, and Massachusetts;* but without proffering a pledge we may not have it in our power to redeem, as soon as we could desire, we trust that we shall be able hereafter to gratify our own wishes by doing justice to able and faithful explorers in these different and responsible fields of science and economics.

10. *Dr. Mantell's Wonders of Geology.*—This fine work was mentioned fully in our July number. Although it was published in London only in March, the second thousand of copies was nearly sold in September, and a new edition is expected early in the present year, 1839.

Arrangements have been made with the author and publisher by which Mr. A. H. Maltby of New Haven will publish the new edition in this country as soon as it can cross the ocean, and by the author's approbation it will appear under the direction of Prof. Silliman with introductory remarks by him: paper, type and illustrations, identical with those of the London edition.

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* We now add those of Virginia, 1st and 2d reports, 1836 and 7 by Prof. W. B. Rogers, Phila. 1838, and of New Jersey, 2d ed. 1836.—Eds.

11. ***Mr. Bakewell's Geology.***—Third American from the fifth English edition of 1838, revised and *improved* by the author: the American edition, by B. & W. Noyes, of New Haven: with an Appendix by Professor Silliman: 8vo. pp. 600.

Mr. Bakewell's excellent treatise is well known in this country, in consequence of the two American editions that have been already published; its plan therefore requires no explanation, and commendation would be quite superfluous in the case of a work already approved and extensively adopted at home and abroad. Mr. Bakewell has added a new chapter on the general removal and disappearance of the coal strata raised by faults above the surface of the ground. The former editions were particularly full and instructive on coal, and this chapter is a valuable addition.

The American editions, that of 1829, from the third English, and of 1833, from the fourth, were edited by Professor Silliman, with the author's privity and approbation, and by his request this third edition is passed over to the American public through the same editorial supervision; with a view of rendering the work more useful, an appendix will be added by the editor, containing a condensed summary of the ground before occupied, with such corrections of fact and theory as appear necessary. This reprint is executed in good style, and numerous typographical errors have been corrected.

12. ***Elements of Geology;*** by Charles Lyell, Esq., F.R.S., &c. &c., London, Aug. 1838, pp. 543, 1 Vol. large 12mo.—These elements are, as may be supposed, an abridgment of Mr. Lyell's large and well known work, the Principles of Geology. This is a new work, and very fully illustrated by figures, chiefly superior wood cuts, of great precision and beauty: there is one colored ideal section of part of the earth's crust; explaining the theory of the four great classes of rocks.

Those who are acquainted with the author's previous works, will expect, what they will find, a lucid and masterly exposition of the science. This work might well be styled, "Institutes of Geology."

It presents the elementary facts, perspicuously arranged and described, and the philosophy of the *science* is such as those familiar with its more profound discussions will readily appreciate. We understand that this work is in the press at Philadelphia, by Kay & Brother, and that it may be expected to appear early in the spring of the present year, 1839.

13. Dr. Lewis C. Beck's ***Manual of Chemistry;*** 3d edition, with numerous wood cuts: New York—1838: pp. 482, large 12mo.—The order of this work is—Definition, Attraction, Heat, Light, Electricity, Galvanism, Magnetism and Electro-Magnetism, Elementary Bodies, Supporters

of Combustion or Electro-Negative Bodies, Non-Metallic Combustibles or Electro-Positive Bodies, Metals, Organic Bodies, Vegetable and Animal, with an Appendix.

This order is probably the most unexceptionable. There is no perfect arrangement; none that will avoid inconvenient anticipations, or that will bring into one group all the members of the same subject. The best course is to anticipate as little as possible; to explain the nature of the materials which we must employ so far as to render our processes intelligible, and to revert, as far as necessary, so that either sooner or later, every thing will be explained. This course Dr. Beck has judiciously pursued, and his work is a perspicuous and condensed abstract of the science, and is well adapted to the object for which it was written.

14. *Notice of a Manual of Conchology according to the system laid down by* Lamarck, *with the late improvements by* De Blainville, for students; by Thomas Wyatt, M. A., in a letter to him from Isaac Lea, Esq., dated Philadelphia, December 19, 1838.—" *Dear Sir—I have* examined your 'Manual of Conchology,' formed from the works of Lamarck and Blainville, and consider it well adapted to the introduction of the student into the science of conchology. The plates, which are from the excellent work of Blainville, are generally very well done, and calculated to aid the tyro in obtaining a knowledge of the genera of this interesting branch of natural history.

"I sincerely wish you success in this work, which must have cost you much labor. Should it pass to another edition, I would advise the insertion of a plate with the various parts of shells, with proper definitions in the text. The name of each shell should also be upon the plates throughout."

Mr. Lea has, with good reason, commended the plates of this work, and it is no small advantage that they are printed on excellent paper, which will bear using both by the quiet student and the traveller. Officers of the navy and in the merchant service, will find this a very convenient, and we doubt not, useful manual, by which to direct their observations while collecting shells to enrich their own cabinet as well as those of public institutions and of private individuals.—Eds.

15. *Eulogiums on the late* Dr. Nathaniel Bowditch.—The death of this distinguished man produced a strong impression on the public mind, and called forth many tributes of respect. Three eulogiums were pronounced, severally, by the Hon. Judge White, at Salem, and at Boston by Rev. Alexander Young, and by Hon. John Pickering, the latter before the American Academy, May 29, 1838. Mr. Young's discourse was, by particular request, revised for this Journal, and appeared in the October

number. This, therefore, has already spoken for itself in our pages, and has been received with warm interest and gratification by the public.

The eulogium of Judge White is a delightful composition, replete with eloquence and literary beauty, and warm with affectionate respect for the great philosopher whom it commemorates. Being the production of a townsman and cotemporary, like Mr. Young's, it presents graphic sketches of his life and character, both in the forming and mature stages, and does equal honor to the head and heart of the writer, and to his noble subject.

The eulogium of Mr. Pickering is a chaste, classical composition, altogether worthy of its author, (and this is no stinted praise.)

In unity with the character of the learned body before which it was delivered, and of which Dr. Bowditch was president, it presents, as its peculiar characteristics, a masterly analysis of the scientific labors of this eminent man. Performed in the midst of arduous and responsible business, and of numerous social engagements and duties, which touched his warm heart as much as science filled his clear intellect, his philosophical labors were enough to have absorbed a powerful mind, unshackled by common cares. It is remarkable, that the eulogist of this eminent man, by the manner in which he has executed his delicate task, bringing literature and science into beautiful harmony, should have evinced that Dr. Bowditch was not alone in reconciling conflicting duties. Every wise and good American must feel proud that his country has produced a subject of such deserved eulogy, and gifted minds and hearts to appreciate such talents, attainments, and virtues.

16. *The Science of Geology, from the Glasgow Treatises, with additions;* first American edition, Common School Treatises, No. I.—This little work of 72 pages, is neatly printed, with good illustrations on wood, and is issued at New Haven by B. & W. Noyes. It is well adapted to be useful in the education of young people, being judicious in selection, and perspicuous and attractive in style.

17. *Dr. Charles T. Jackson's Reports on the Geology of Maine.*—It has been impossible for us to notice in the present number Dr. Jackson's very valuable reports, being the second on the geology of Maine, and the second also on the geology of the public lands of Maine and Massachusetts.

These reports together occupy about 300 pages, with appropriate illustrations. They correspond with what we might expect from Dr. Jackson, being able and perspicuous, and eminently adapted to do honor to the State, and to promote its vital interests.

We trust that the good sense and patriotism of the government of Maine will carry out this noble work until it is entirely finished under Dr. Jackson's able and efficient management. No time for a full completion of this great labor can be so good as the present; an abandonment would be most unwise,—even a suspension highly injurious, and in point of economy, very improvident and wasteful.

18. *Catlinite*[*] *or Indian Pipe Stone.*—Dr. Jackson, of Boston, has analyzed Mr. Catlin's pipe stone from *Coteau du Prairie,* which is not steatite, but a new compound very similar to agalmatolite, it being composed of in 100 grains:

| | | |
|---|---|---|
| Water, | 8.4 | grs. |
| Silica, | 48.2 | " |
| Alumina, | 28.2 | " |
| Magnesia, | 6.0 | " |
| Perox. iron, | 5.0 | " |
| Ox. manganese, | 0.6 | " |
| Carb. lime, | 2.6 | " |
| Loss, (probably magnesia,) | 1 | " |

The carbonate of lime is not an essential ingredient, but is mixed in fine particles.

The Catlinite evidently exists in pseudo strata or tabular sheets, and overlaid by quartz rock, glazed, as if from the action of fire, while the surface is carved with bird tracks, called by the Indians the points or footsteps of the great spirit.

19. *Encke's Comet.*—The proximity of this body to the earth, during its return in the latter part of the present year, has rendered it an object of peculiar interest to astronomers. It was seen in England as early as the 21st of September, but as yet no foreign observations upon it have reached us. Unfortunately, an ephemeris of this comet was not obtained in this country until the middle of November, at which time it had passed the circle of perpetual apparition, and was visible but for an hour or two in the evening after sunset. It was first seen in this country on the 17th of November, and at a number of places simultaneously; at Yale College, New Haven, at the Wesleyan University of Middletown in this State, and at Philadelphia. It had then recently passed the point of its nearest approach to the earth, which was about 21 millions of miles, and was visible to the naked eye as a star of the 4.5 magnitude.

We have, as yet, heard of no regular series of observations upon the comet made in this country. But few days remained after its discovery before it should disappear in the evening twilight, and its proximity to the horizon promised little reward to any efforts that might be bestowed upon it. It was observed here with the 14 feet reflector of Mr. Smith, described in the last number of this Journal, and with particular reference to its size and actual appearance. There was no decided or clearly defined nucleus, but its degree of condensation towards the center, was about as much as in the kind of nebulæ described by Sir J. Herschel as "suddenly much brighter in the middle." The nucleus was excentric, the coma being less extensive on the side opposite the sun than elsewhere. The greatest diameter of the coma was in this telescope fully 12′; its least not more than ⅔ as much, and in the direction of a line drawn towards the sun. The expected occultation of the star *i* Herculis, which was not visible in Europe, was observed here. It did not occult it, but preceded it when nearest by about 10 or 15 seconds of time. A small star of the 9th or 10th magnitude about 5′ south preceding *i*, was almost centrally occulted, but before the nucleus had quite reached it, the comet was too low to be observed; the nucleus had approached within 30″ of the star, and in a few minutes, would have either occulted it or passed very near it on the side next to *i* Herculis.

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[*] After Mr. Catlin, the celebrated traveller in the West, and the successful painter of Indians, their costume, the scenery of their country, &c. His Indian museum is a most interesting and unique collection.

The Bibliothèque Universelle of Geneva gives an abstract of the Ephemeris of this comet, as calculated by M. Bremiker, under the direction of M. Encke. Its present return is peculiarly interesting on account of its near approch to Mercury, from which its nearest distance is not two millions of miles. The perturbations of the comet, arising from this so close proximity to the planet, will furnish data, from which the mass of Mercury, hitherto little more than conjectural, may be known to a great degree of exactness. The full advantage of these data for the calculation of the mass and density of Mercury, will not, however, be realized, until future returns of the comet have more completely fixed its elements.

It is somewhat remarkable, that since the return of Halley's comet, no other than this has been seen in any part of the world. E. P. M.

Yale College, December 29, 1838.

20. *Grave of Godfrey, the inventor of the Quadrant, and of Charles Thomson.*—It will be interesting to the friends of science to learn that the remains of Thomas Godfrey, the undoubted inventor of the Quadrant, have been rescued from oblivion and removed to the beautiful cemetery of Laurel Hill, near Philadelphia. Mr. Godfrey had been interred on the farm of his father, near Germantown; in the course of time, the family burial ground was crossed by a cart road, and the old soapstone monument of the father, bearing date 1705, was knocked regularly by a cart wheel every time it passed, and was thus much defaced. This emphatically exhibits the folly of interring on farms, which must pass, in this country, after a few generations, into other families.

Appreciating fully the discovery of Godfrey, and anxious to prevent a further desecration of the grave, the annalist of Philadelphia, John F. Watson, Esq., who resides in Germantown, has had the remains of Godfrey, of his father and mother, and of a small child, all disinterred with suitable care, and we are happy to add, that the managers of the Laurel Hill cemetery have erected a suitable tomb over the remains. The friends of science, when viewing this already celebrated spot, will not forget to visit the tombs of Godfrey, the inventor of the Quadrant, and of Charles Thomson, the first, and long the confidential Secretary of the Continental Congress, also to be found appropriately ornamented in the same cemetery. It is high time other attempts were made to perpetuate the memory of the great and good men of the Revolution.—*Com. by Mr. Smith of the Phila. Library.*

21. *Marble and Serpentine in Vermont.*—We have received some beautiful marble tablets from Vermont through Mr. Ilock Hills, agent of the *Black River Marble and Manufacturing Company.*

The quantity is stated to be inexhaustible.

The marble proper, is in the town of Plymouth, county of Windsor, twenty five miles west of Connecticut river.

Some of the pieces sent to us have a white basis, with a faint blush of red, and varied by clouds of a light chocolate color; the structure is *sub*-crystalline, almost compact, and the same is true of other pieces whose basis is black, but beautifully pictured by white spots, tinted in some parts with gray. The white is often elongated into figures, having considerable regularity, sometimes almost cylindrical, and suggesting, at a transient glance, the idea of imbedded encrinites, or other organic remains. It is scarcely necessary to remark, that this is not the fact; and, indeed, the geological character of the country from which the marble comes, is primary, and destitute of organic bodies.

The serpentines and serpentine marbles are from the neighboring town of Cavendish.

The color presents every shade of green, and becomes, by easy transitions, deep leek-green and almost black. A piece of the latter color, 12 inches by 10, now lies before us, and is so highly polished as to be a good mirror; it is, indeed, very beautiful. The lighter colored pieces have considerable resemblance to the Verd Antique of Milford, Connecticut.

We cannot doubt that these materials will prove important both to useful and ornamental architecture. The pieces before us are all very firm, and would indicate good quarries.

The serpentine graduates, we are informed, into soapstone of an excellent quality, and the distance of the quarries of serpentine and soapstone from the river is less than that of the marble. We observe in these serpentines magnetic oxide of iron and chromate of iron, both so characteristic of serpentine formations.

### 22. *Oil from White Fish.*

Madison, September 12, 1838.

To Prof. Silliman.—*Respected Sir*—The question has often been proposed to me, whether by some chemical or natural process, the oil contained in our "white" fish might not be extracted without material detriment to them as a manure. You are probably aware that in our vicinity we rely in a great measure upon these fish as a manure for the "worn out lands." For this purpose, at least one hundred and fifty of our most active men are in the season engaged in taking them. The number taken yearly is, upon average, fifteen millions. It has been ascertained by repeated experiment, that these fish contain half a gill of pure oil apiece. By those who made the experiment, (who at the time consulted you upon the subject, viz. 1814 or '15,) the remnants, after the extraction, were applied, side by side, with fish just taken, and no material difference noticed in the crops. They at that time extracted from 7000 fish, value $7, a barrel of oil, value at that time $25; the process was very tedious and filthy. From these premises, sir, I wish to ask of you, whether the oil contained in these fish can be purified from the other matters. Does the principle of manure consist in the solid material parts of the substances used, or in a gas arising from the decomposition of such materials? Is the oil the principal source of manure, and if so, in what ratio? I have been induced to solicit your opinion in this matter from a conviction that a very large profit may be realized from a disposition of the fish in the manner suggested, provided any method can be devised for effectually separating the oil from the other parts.

Yours with great respect,
W. W. Wilcox, A. M.,
Prec. Lee's Academy.

Being unable to suggest any thing satisfactory in reply to the letter of Mr. Wilcox, we give it publicity, in the hope that it may elicit information from others.—Eds.

23. *Calcium.*—We learn from Prof. Robert Hare, that he has recently, by a new process, obtained calcium, the metal of lime, in considerable quantity. His process is new, and we will not presume on a private letter for any of the details of procedure, or of the properties of the metal, of which, we trust, the public may, ere long, receive a notice from Dr. Hare himself.

24. *N. Dunn's Chinese collection at Philadelphia, communicated.*—It would be difficult to name a subject that has puzzled the learned world so much and so long, as the accurate delineation of the character of that wonderful and unchanging people, the Chinese. The

English embassies added something to our knowledge of the heretofore little explored interior of the country, and some light was diffused respecting the condition of agriculture, the habits, and the manufactures of the country. The works of the missionaries have also tended to make us more familiar with some of their peculiarities; the best book, however, which has ever been written respecting China, is the recent work of Mr. J. F. Davis, who had long been a resident in China, and who accompanied the embassy of Lord Amherst to the capital city of Pekin. Mr. Davis has concentrated much real information in a small space, and has, with singular ability, developed the characteristics of the three hundred millions of people of this region; his volumes have been republished in Harper's Family Library, and it is *to them*, and to the recent *Fan-Qui in China*, in Waldie's Library, that we would direct the attention of the inquirer.

Another new effort to open a fruitful source of information to the student is about to be made public, and on this occasion it is our own country which is to be gratified by the industry, zeal, and discriminating judgment, of one of her native merchants. Europeans have never succeeded in transporting a perfect or even a very respectable collection of Chinese curiosities. Those impressions which would be received by a resident who had enjoyed the rare privilege of unrestrained intercourse with the better classes of Chinamen, have been denied to foreigners. It has been too much the custom of the natives and their visitors, mutually to despise each other, and for both to seek for little further communication than that which the nature of their commercial transactions demands. The consequence has been, that the articles exported have continued to be principally those only which European and American every-day life have required; while strangers have limited their purchases to the common articles made to suit a *foreign* demand and taste, and their intercourse to the classes of natives who are appointed by government to serve or to watch over them. A few streets of the "outside" city of Canton are generally visited, and the stores in the vicinity of "Hog-lane," a place frequented by foreign sailors, are ransacked for the well known manufactures of gew-gaws, successively carried off by every new comer, but possessing little novelty in any sea port. The interior of the city of Canton even is a sealed book; how much more then the interior of China itself. This being the case, it became an interesting problem, as the Chinamen refuse to admit us *in*, how it would be possible to bring *out* what it was so difficult to get a sight of; in other words, as foreigners were not permitted to inspect the workshops, the houses, private apartments, and manufactories of the empire, what was the next best thing that could be done to enable those outside the walls, and at home, to become acquainted with the domestic affairs and tastes of these recluses. Certainly little could be expected from the natives, unless other methods than those heretofore practiced could be adopted.

Nathan Dunn, Esq., of Philadelphia, who had reflected much upon this subject, and who, in the course of the very successful prosecution of his business at Canton, had learned to respect the ingenuity, and when called forth, the intelligence of the numerous Chinese with whom he was daily in contact, happily conceived the idea of transporting to his native shores, *every thing* that was characteristic or rare, whether in the natural history, or the natural and artificial curiosities and manufactures, no matter how costly they might be. And now came efficiently to his aid those requisites that had been but too frequently wanting in the officers of the East India Company, or their agents, who had made the attempt to procure such a collection but had failed. Mr. Dunn, who, it will be admitted by every one on the spot, had conducted himself toward all classes in a manner to win their esteem and confidence, and to whose house and table were introduced so many of the most distinguished officers of government, either temporarily or permanently at Canton, soon discovered that it was in his power to obtain favors not usually granted to strangers. One after another he procured, either by purchase or as presents, those rare and costly articles constituting his collection: how many of these are *perfect novelties* even to thousands who have visited China, let those decide who may soon have an opportunity of doing so; if indeed, that opportunity is not already in their power, before this hasty notice passes through the press. For one, the writer is free to say that but for the insight thus obtained, he should have remained as ignorant of the subject as other travellers. It is with a view of imparting a portion of this satisfaction, that he ventures to put them on paper.

Without further preface, we shall proceed to notice very briefly some of the peculiar features of this novel exhibition, enumerating a very small portion of the contents of the three hundred cases from which it has been now for the first time unpacked. The following are the principal groups.

*The entrance saloon*, of China work, forms a vestibule, through the centre of which you enter the great saloon, one hundred and sixty feet in length, by sixty three in width, and twenty four feet in height, with a double colonnade; to the right and left of which are the numerous cases containing specimens of all that is rare, curious, or common, to be procured in the celestial empire. This screen is such as is common among the wealthy Chinese, in partitioning off a very large saloon from the remainder of the great ground floor of their houses. It is richly gilt, and ornamented with Chinese paintings on silk, inserted in the pannels; and is mounted above with small square gilt apertures; in these latter are inserted paintings of boats and gorgeous flowers. The screen forms a beautiful termination to this end of the room; the full effect bursts upon the eye of the visitor after passing the folding door. Hours, nay, days and weeks, may be profitably employed in examining the details within this magnificent saloon, which brings the most populous nation of Asia at once before the view of the spectator.

*Accurate likenesses in clay.*—The visitor is first attracted by the accurate and characteristic whole size Chinese figures of various rank, from the mandarins to the cooleys, from women of distinction, to those sculling their boats on the rivers. These are in number seventy or eighty, and were made by a very experienced artist in this line, from living subjects. The material of the faces and hands is a prepared substance, so well adapted to the operation of moulding, as to take the impression perfectly and retain it permanently; the faces are colored to nature, mounted with hair, &c., and each presents a speaking countenance in a style of art perfectly novel in this country or Europe. These figures are neatly arranged in groups, arrayed in their appropriate costumes, some of them extremely rich, while others exhibit the working and every-day dress of the lower orders. The effect of this department is to exhibit to the spectator the inhabitants of China as they really exist. Great care was taken in procuring the likenesses, and about three years of the time of the proprietor were occupied in bringing them to perfection; his head carpenter, and other workmen about the factories, were pointed out to us, and many conspicuous characters of China street, &c. will be recognized at once by those who have been to Canton. Bearers of a sedan chair, itself a perfect specimen in all its parts of ornament and utility, are in the act of carrying a native gentleman, accompanied by his pipe-bearer and footman.

*Porcelain and earthen ware manufacture.*—In this department, endeavors have been successfully made to procure the best specimens of all the most expensive manufactures of the country, embracing several very ancient and highly esteemed articles. There are also those articles in common use for domestic purposes, to ornament grounds, fish ponds, or used as flower stands, seats, &c. A very interesting fact will be developed by this section, showing that the art of porcelain manufacture has been on the retrograde for the last century or two; it will also serve to show, that many of the most ornamental and beautiful specimens are rarely, if ever, exported. Formerly the emperors patronized the porcelain manufacture by very high premiums and extensive orders; the art has now dwindled to supplying commercial and domestic wants. There are here many hundred jars, vases, pipe-stands, and various services used by the Chinese, differing materially from those exported. The specimens of ware cracked on the surface by age, are interesting and costly. There must be several thousand pieces of fine China, including the thin egg-shell cup with its lettered inscriptions, octagon pipe-stands, three or four feet in height, inscribed landmarks, tile work, screens, &c. &c., in very numerous patterns; affording us "barbarians" new ideas on the subject of their manufactures, and probably new patterns for our artists.

*Agricultural and other instruments.*—We notice among the agricultural instruments the very crude plough, that is drawn by the buffalo with his simple yoke and rope traces; the harrow, differing very materially from that of our country, is one of the accompaniments. There are forks, rakes, hoes, axes, shovels, spades of wood faced with iron for the sake of economy, &c.; a complete set of carpenter's and joiner's, or cabinet maker's tools; of the superiority of these over our own, we cannot say much. There is a native shoemaker's shop complete; a blacksmith's anvil, his curious bellows, &c., comprising the complete accoutrements of the travelling smith: the entire shop of the ambulatory barber, his clumsy, short razor, cases, &c. &c. The musical instruments of the Chinese, also figure in full among the curiosities. Castings of iron of very great beauty, consisting of pots, kettles, and other cooking utensils of universal use, and which, unlike our own of the same metal, may be mended at pleasure as easily as our own tin vessels.

Here is a study of Chinese manufactures perfectly novel to an American, who will be surprised to find that the most simple operation which he has been taught to believe can be performed only by an instrument of a certain form, is equally well executed by another of a totally different figure; the flat-iron, for instance, is more like our chafing-dish than what we employ for smoothing linen. We are amused to see the New England *patent* mouse-trap, that has been used in China for ages. There are gongs, bells, metallic mirrors, and articles under this head which nothing short of a most copious descriptive catalogue would embrace.

*Models of boats.*—The models of boats form a striking feature of the scene; first, we have the gorgeous flower boat with its numerous decorations, various furnished apartments of comfort and luxury, and painted and adorned in the peculiar style of the Asiatics.

*Of the canal boat* there are three models of different sizes of such as are used in conveying the articles of their produce, teas, salt, grain, and manufactured articles, to and from the distant points of the extensive empire, and in loading and unloading foreign ships. They are remarkable for strength and durability.

*The man-of-war boat.*—These tidewaiters' boats, or cutters, are always cruising about with the police officers, to keep order among the numerous residents on the water, and to enforce the revenue laws.

*The san-pans*, or family boats, in which it is computed about 200,000 persons constantly reside on the waters before the city of Canton and its suburbs; they are kept as clean as a milk-pail, and contain entire families, who are born and live to the end of their days on the river. This great city of boats presents a remarkable aspect; through them it would be difficult to navigate, were it not that the fleet is arranged in streets, and at night lighted up. There are also other boats; each has been made by reducing the dimensions to the proper scale; in every particular, even to the employment of the same descriptions of wood, the oars, sculls, rudders, setting poles, cordage, &c., are fac-similes of those in actual use. We are not sure that a Chinese canal boat, of a thousand years ago, might not be advantageously transferred to our own recently introduced water ways.

*Bridges.*—There are four accurate models of granite bridges, from one to four arches; the workmanship of the originals is of great beauty and durability, and really in them we discover the perfect arch, the most approved piers of the present day, and yet their bridges are so ancient, that the date of their erection is almost, if not entirely, lost. Having no carriages, they are merely used for foot passengers, loaded cooleys, and an occasional horse or buffalo.

*Summer houses.*—Four models of summer houses exhibit the peculiar taste of the Chinese; some are plain, and others very ornamental, with their scalloped roof, bells, gilding, painting, &c., and furnished with miniature chairs, tables, &c., models of real things, every part being complete for the luxuries of tea and the pipe. Tea is the universal beverage; this is sold from eight cents the pound up to many dollars, and is an article on which some of their citizens expend a very large income. The working man carries it in his rude tea-pot to the fields, and drinks it cold to quench his thirst, while the more wealthy sip it on every occasion of ceremony, business, or familiar intercourse.

*Paintings.*—The pictures and paintings are very numerous, and probably occupy the greatest surface in the collection. Many of them were presented by distinguished men of China, and many were painted by the most celebrated artists of the principal inland cities, including the capital. They represent in the first place all those scenes which are characteristic of Chinese life in its detail, including a series showing every process of the tea manufacture, from the planting to the packing up. There are large and handsome views of Macao, Bocca Tigris, Whampoa, Canton, and Honan, with its remarkable temples, &c. The portraits will astonish those who have seen only the paltry daubs usually brought as specimens of the art in China. There is one of the high priest of the Honan temple, and others of distinguished men well known in Canton, worked with the minuteness of miniature painting. This department comprises also a variety of paintings on glass, an art much practiced by the natives; pictures of all the boats peculiar to the country; of rooms, their domestic arrangements; of all the costumes of people of rank; the furniture, lanterns, and, in short, of every variety of Chinese life, from the most degraded class to the emperor. The flowers embroidered on satin, &c., will attract the eye of female visitors.

*A Chinese room.*—At the east end, faced by a very superb alcove brought from China, is a Chinese room. The alcove itself consists of wood deeply carved out of solid blocks; the carving represents figures of men, animals, birds, flowers, &c. The cutting penetrates through the whole of each piece, and forms a net work, the front being painted and gilt in the Asiatic taste, with the rich colors for which the nation is so celebrated. The screen is a fac-simile of those put up in the houses of the wealthy, to form an ante-room in their large establishments. This vestibule will be decorated with furniture, such as chairs, tables, stands, stools, vases, maxims, scrolls, &c., and in every respect will represent a room as actually occupied by the rich. This screen work extends over the tops of the cases the entire length of the north side of the room, and its effect, as seen by the writer, is extremely gorgeous, reminding him of the representations made in old illuminated manuscripts, before the invention of printing in Europe. The colors, violet, blue, crimson, scarlet, &c., are those employed by the illuminators, and lead one to believe that *they* imitated the Chinese.

*Furniture, books, &c.*—In addition to the furniture contained in this beautiful pavilion, there will be also distributed in the saloon a variety of Chinese domestic articles and utensils. Two dark colored and extremely rich bookcases, which might serve to ornament any library, will display copious specimens of the books of the Chinese, in their peculiar and safe binding, so rarely seen in this country. Specimens of their blocks or stereotyped wood are also in the collection. The bookcases are made in excellent taste, of a dark wood susceptible of a beautiful polish, and in some respects they may be considered an improvement on our own. The chairs of different forms, large and capacious, made of wood resembling mahogany, with their appropriate cushions and footstools, are in a taste of refinement and comfort, which would have been creditable to some of our forefathers of New England, into whose parlors they might have been introduced without differing much from the fashion of fifty years since. The stools without backs exhibit their adaptation to a southern climate, in being partly composed of China ware, marble, and wood.

There are also tables, such as ornament the rooms of the wealthy, gilt, and richly carved and painted; stands, inlaid with marble or precious wood, such as are placed between every two chairs to hold the tea apparatus, or those various little ornaments or flower pots, of which the Chinese it will be seen, are so remarkably fond. There is also a common table, such as is in universal use, and has been for centuries, which will be recognized by our present generation as a facsimile of the favorite eight legged table of our great grandfathers, now thrust by modern fashion into the kitchen or garret. It folds up as those do, and the legs are turned in rings; this, like a thousand things in the saloon, proves that our common usages have been derived from China, where we are accustomed to believe they are centuries behind us. The vases and seats of porcelain are particularly rich and unique.

*Natural history.*—The brevity we have been obliged to use in the foregoing enumeration, has prevented the mention of much that would have interested the readers of this Journal, and we have to regret that the department of natural history must be also merely touched upon. It evinces the comprehensiveness of Mr. Dunn's plan to find, that even in this particular, nothing has been omitted which time, trouble, and expense could accomplish, and as one evidence among many, of the laborious nature of the occupation of bringing these things together, we may mention the care bestowed upon the numerous objects of science here concentrated.

A young gentleman of Philadelphia, well known there as an enthusiastic naturalist, Mr. William W. Wood, son of Mr. William Wood, made his way to Canton in search of objects of interest, in the reasonable expectation of bettering his condition. Mr. Dunn at once sought his aid to perfect his collection, and employed his valuable time for a very considerable period. He had a *carte blanche* to procure objects in natural history, yet some art and no little subterfuge were necessary, to persuade the Chinamen to collect articles of a kind in which they take no interest; prejudice and national feelings were to be overcome before they could be induced to make the necessary excursions by land and water, to spots where no foreigner could penetrate. By industry, money, flattery, and kindness, he succeeded, however, in amassing a great variety of birds, fishes, reptiles, shells, &c., and a few animals. Of these, all have arrived in good condition with the exception of the insects; the butterflies, moths, &c., which when last seen in Canton were particularly rich and curious, have suffered most by the delay in unpacking, and by natural causes.

Mr. Wood was indefatigable for many months in completing the herpetology of China; the conchology is fully represented in many rich and rare specimens; and one of the rarest birds, the mandarin duck, with its very peculiar plumage, will be new to many: the China partridge and many beautiful song birds, add variety and interest to the whole.

The fishes were procured principally at the famous fishing stations at Macao, where Mr. Wood resided for several months for this express purpose; the specimens are very numerous and rare. There has also been procured a great number of very fine drawings of fish from life in the accurate style of the Chinese, and in fine colors. The stuffed specimens will be neatly and appropriately arranged to afford a study for the naturalist.

In the department of botany, attention has been paid to procuring accurate drawings of many plants and flowers. These will be exhibited in frames.

The *minerals* in this collection are few in number, and together with the primitive rocks of China, embrace some remarkably fine carbonates of copper, both nodular and radiated.

The *shells* include the well known species of the China sea and the Canton river; the former, however, are of remarkable size and beauty, while a multiplicity of specimens illustrates all their varieties.

The writer regrets his want of acquaintance with the science of mineralogy, which prevents his more than alluding to the specimens, said to be highly interesting.

*Miscellanies.*—The jos-houses, pagodas, articles of *virtu*, of ornament, of stone, of jade, of ivory, bamboo, wood, metal, rice, &c., are so numerous that we can only allude to them. A case of shoes in all their clumsy or ornamental variety, exhibit the form of the compressed female feet, and the clumsy shape of those of the male; another of caps fresh from their makers, with the button of office, and the cheaper kinds of the poor; theatrical dresses, known to be those of the very ancient Chinese, spectacles, opium and other pipes, fans the compass in great variety, models of fruits, coins, exquisite specimens of carving in ivory, metal, stone, and bamboo, very numerous and grotesque carvings from roots of trees, in which they exhibit a peculiar taste, singular brushes, combs, beautiful vessels of odoriferous wood for their altars and temples, of which latter there are models; very numerous ornamental stands carved with good taste; huge cameos in stone of great cost; fine specimens of their lacquered ware, as well as their common ware; a silk embroidered saddle; a water wheel worked like our *modern* tread-mill; a fan for cleaning rice resembling our own; lanterns of every possible shape, size, and ornament, will be suspended from various points, with their rich and tasteful paintings; there is a model of their very singular coffin, which few would even guess was designed to contain the last relics of humanity.

Space is wanting to perfect this notice of a collection highly creditable to the taste and liberality of the proprietor, and valuable to our country. No where else can we see so complete an exhibition of this interesting nation.

25. *Prof. Agassiz and his works.*—By a letter from this eminent naturalist, dated Neuchatel, Nov. 5, 1838, received Jan. 4, 1839, at the moment of closing the present No., we learn the following facts respecting his new works now in the course of execution. The work on THE FRESH-WATER FISHES OF EUROPE,* with numerous plates, executed with all possible care, and that on the ECHINODERMATA,* will be published in such time, that the first number of each may arrive in this country early in the present year, 1839. *The fresh water-fishes* will appear in livraisons, containing each about 20 plates. The *Echinodermata* in livraisons, with 5 plates each, containing also the explanatory text.

It is known to the geological world, that Prof. Agassiz has recently published some novel and interesting views respecting the movement of the Erratic Blocs of the Jura, and upon Glaciers Moranies and Erratic Blocs.† On this subject he remarks in his letter:

"You will greatly oblige me if you will communicate to me such facts within your knowledge as have reference to the phenomena of the transport of erratic blocs, and especially with respect to polished surfaces in any regions in the vicinity of New York (or elsewhere.)

"I have it in contemplation to publish, in the course of next year, the result of extensive researches into this subject, and shall be very happy to add observations made in countries remote from 'my own.'"

We have only room earnestly to recommend the works and wishes of Professor Agassiz to our geologists, and his wishes especially to those charged with the geological surveys. His address in this country is to M. August Mayor; care of Meyrat Nagath, New York.—EDS.

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* For a notice of these works, see vol. 34, p. 212 of this Journal.

† Jameson's Journal, for Oct. 1837, and April, 1838, vol. 24, pp. 176 and 364.

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Fig. 1

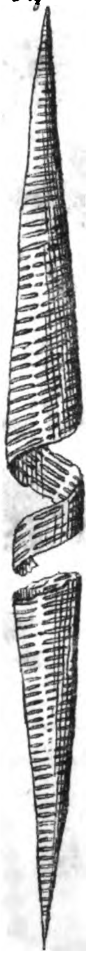
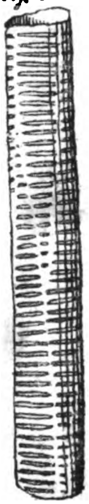


Fig. 2



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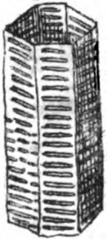

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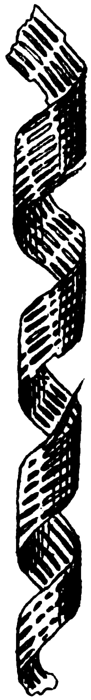

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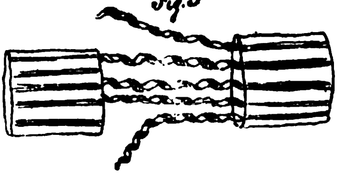


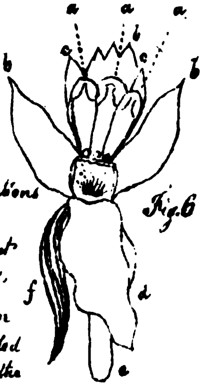


Fig. 6

Fig 1. Conical terminations of ducts in Ferns

Fig 2. Cylindrical duct

Fig. 3. Prismatic duct

Fig 4 Duct torn between the bars and uncoiled

Fig 5. Two portions of the bundle of vessels, connected by torn ducts.

Fig 6. A monstrous flower of Orchis spectabilis

a. a. a Three perfect anthers

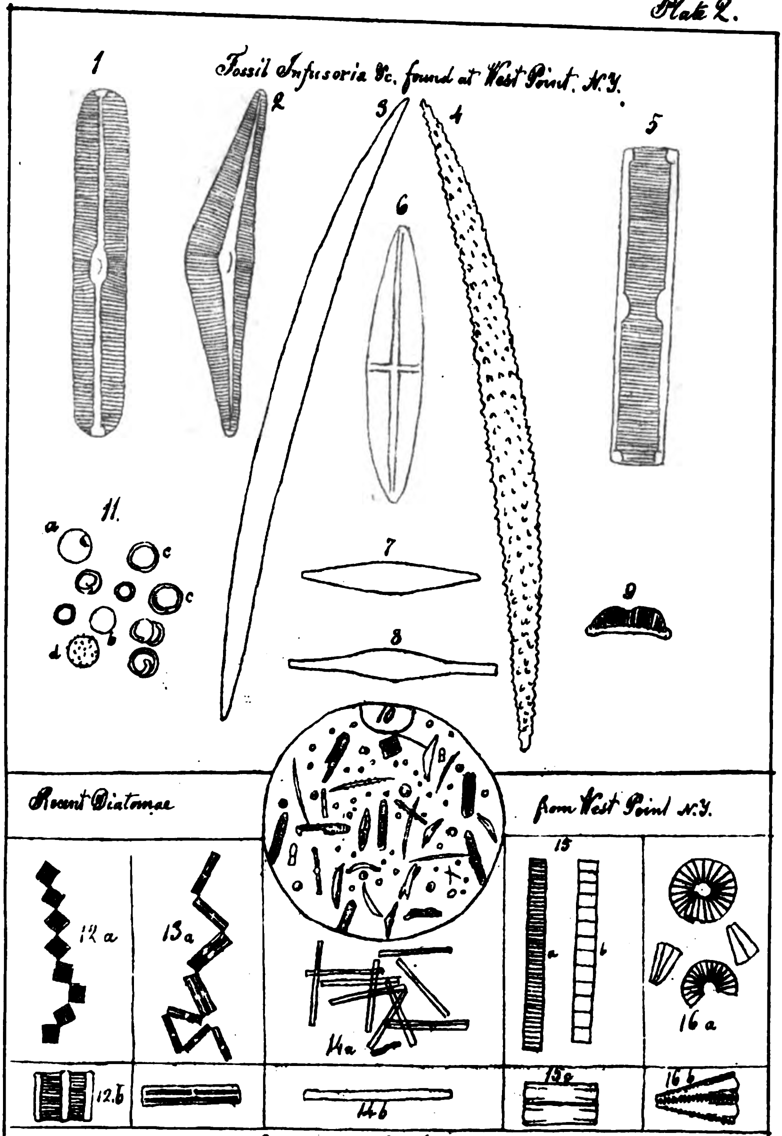
b. b. b Sepals

c. c. d. Petals and Lip

e. Spur

f. Ovarium

From nature and on stone by J. W. Bailey



Explanation of the figures

Fig. 1. 2. 5. 6. 7. 8. 9 Siliceous shells of Infusoria found in Peat earth at West Point.

Fig. 3. Smooth round siliceous body.

Fig. 4 Rough " siliceous body.

Fig. 10 Appearance presented by a portion of the Peat earth diffused in water and magnified moderately.

Fig 11 Spheres, (a) Disks, (b) Rings (c) &c. found very abundant in the peat earth.

Fig. 12. Diatoma flocculosum

Fig 13. Diatoma tenue?

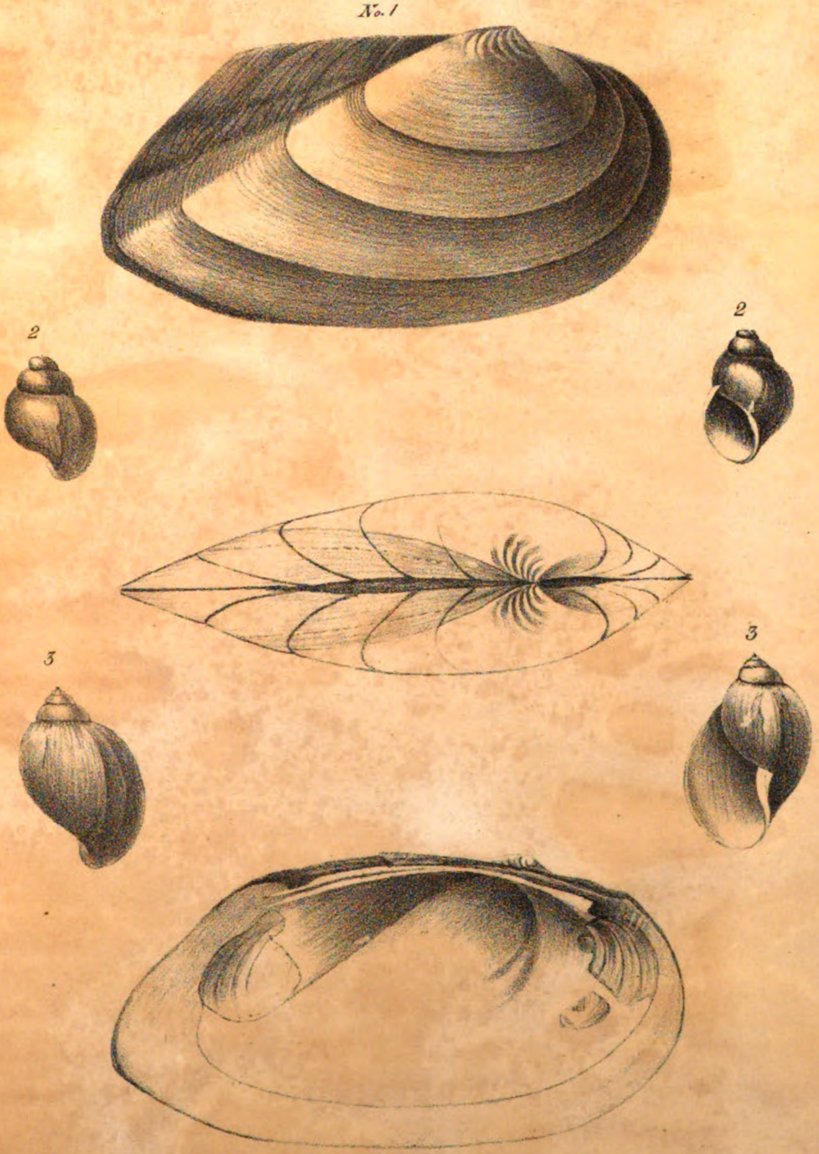
Fig. 14. Diatoma crystallinum?

Fig. 15 Fragillaria pectinalis

Fig. 16 Meridion vernale?

The figures marked (b) are sketches of single articulations greatly magnified.

From nature and on stone by J. W. Bailey.



*No. 1 Unio Sayii_Ward*

*" 2 Heterostropha, Kirtland*

*" 3 Phy$\overset{s}{\wedge}$a Sayii, (Hab. Lake Pepin Ohio)*

P. S. Duval. Lith. Philad.